DEPARTMENT OF THE ARMY TECHNICAL MANUAL

DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER

TM 11-5041

TO 33A1-4-33-1

FIELD STRENGTH METER

AN/URM-91

DEPARTMENTS OF THE ARMY AND THE AIR FORCE

OCTOBER 1956

FIELD STRENGTH METER AN/URM–91

TM 11–5041
TO 33A1–4–33–1
CHANGES No. 1

DEPARTMENTS OF THE ARMY AND
THE AIR FORCE
WASHINGTON 25, D. C., *27 May 1957*

TM 11–5041/TO 33A1–4–33–1, 15 October 1956, is changed as follows:

Page 4, paragraph 5. Make the following changes in the table:

In line 7, change "Cord CD–307A" to: **Electrical Special Purpose Cable Assembly.**

Add the following to the table:

Nomenclature	Common name
Branched Electrical Special Purpose Cable Assembly.	External power cord.

Page 4, paragraph 6*a*. Make the following changes:

Line 3. Change "Cord CD–307A" to: **Electrical Special Purpose Cable Assembly.**

Line 4. Change "External power cord" to: **Branched Electrical Special Purpose Cable Assembly.**

Page 6, Figure 3. Delete "CORD CD–307A." Delete the parentheses from "POWER CORD."

Page 13, paragraph 14*a*. In the function column, delete the second and third sentences opposite "RESPONSE switch" and substitute: BROAD position is used for normal operation. SHARP position is used when an incoming signal is weak or when another signal is close in frequency.

Page 15, paragraph 16*e*. Insert as the first sentence: Set the FM DISCRIMINATOR switch to OFF position.

Page 16, paragraph 17. Make the following changes: Insert the following note immediately below the paragraph heading:

Note. Calibrate the gain of the receiver with the OUTPUT switch set to the position in which it will be used during operation. Usually, the LOG position is used only when a recorder is connected to the receiver.

a. In the "Setting" column, change "LIN" to: **LIN for normal operation; LOG if a recorder is to be used.**

Delete the table in *c* and substitute:

Control	Setting
CALIBRATE SWITCH	ON CAL OSC.
FM DISCRIMINATOR switch.	OFF.
OUTPUT switch	LIN for normal operation; LOG if a recorder is used.
ATTENUATOR control	66 for linear operation; 40 for logarithmic operation.

Page 17, paragraph 18.

g. (Superseded) When the OUTPUT switch is in the LOG position, read the signal-level indications on the upper (red) DB scale on the signal-level meter.

Page 32, paragraph 40*c*. Delete the fifth sentence and substitute: BROAD is used for normal operation; SHARP is used when an incoming signal is weak or when another signal is close in frequency.

Page 40, figure 24. Change "CORD CD–307A" to: **POWER CORD.**

Page 42, paragraph 52*e*, line 2. Change "FR" to: **RF.**

Page 43, paragraph 54, line 1. Change "cable" to: **cord.**

Figure 38 (fold-out). Change "CORD CD–307A" to: **POWER CORD.**

[AG 413.44 (6 May 57)]

By order of the Secretaries of the Army and the Air Force:

MAXWELL D. TAYLOR,
General, United States Army,
Chief of Staff.

Official:

HERBERT M. JONES,
Major General, United States Army,
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CNGB	Sp Wpn Comd	Army Elct PG
ASA	Engr Maint Cen	Yuma Test Sta
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Hq CONARC	Sig Sec, Gen Depot	JBUSMC
CONARC Bd	Sig Depot	Units organized under following TOE's:
CONARC Bd Test Sec	WRAMC	
Army Air Def Comd	AFIP	11–7
OS Maj Comd	AMS	11–16
OS Base Comd	POE (OS)	11–57
Log Comd	Trans Terminal Comd	11–127
MDW	Army Terminal	11–128
Armies	OS Sup Agencies	11–500
Corps	Army Comm Agency	11–557
Div	Army Sig Pub Agency	11–587
US Army Tng Cen	Army Sig Comm Engr Agency	11–592
Ft & Cp	White Sands Sig Agency	11–597

NG: State AG; units—same as Active Army.
USAR: None.
For explanation of abbreviations used, see SR 320–50–1.

U. S. GOVERNMENT PRINTING OFFICE: 1957

FIELD STRENGTH METER AN/URM–91

TM 11–5041
TO 33A1–4–33–1
CHANGES No. 2

DEPARTMENTS OF THE ARMY
AND THE AIR FORCE
WASHINGTON 25, D.C., *21 August 1961*

TM 11–5041/TO 33A1–4–33–1, 15 October 1956, is changed as indicated so that the manual also applies to the following equipment:

Nomenclature	*Order No.*
Field Strength Meter AN/URM–91	39187–PP–58

Page 17, figure 10, legend line, add: (Order No. other than 39187–PP–58).

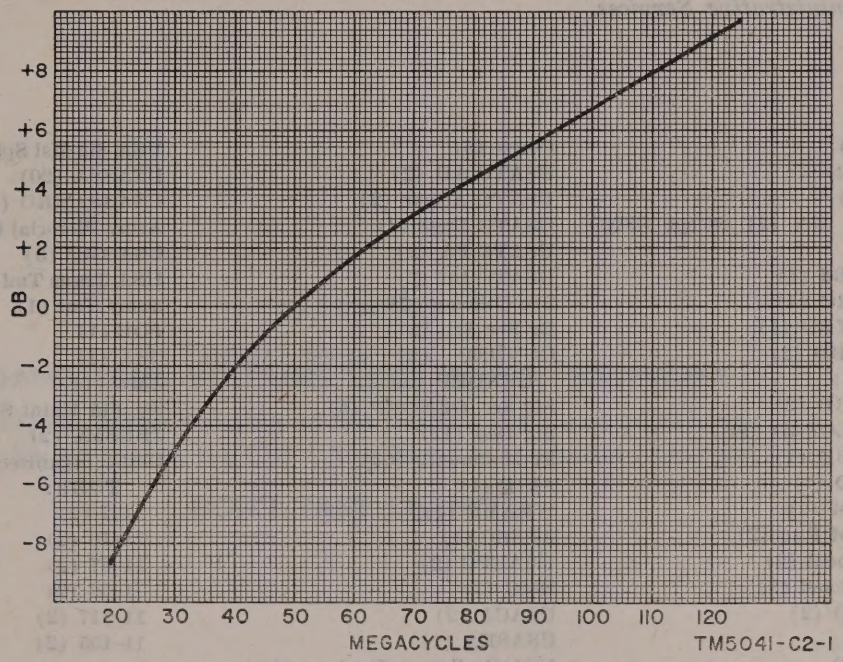

Figure 10.1 (Added) *Graph of antenna coefficient (K), in db, versus frequency (Order No. 39187–PP–58).*

Page 36, paragraph 45*b*, line 10. After "diodes," add: (1N69A on Order No. 39187–PP–58).

Page 38, figure 23. Make the following changes:

1. Below CR101 and CR102, add: (NOTE).
2. Add the following note:

NOTE

ON EQUIPMENTS WITH ORDER NO. 39187–PP–55, CR101 and CR102 ARE TYPE 1N69A.

Page 66, figure 38 (foldout). Make the following changes:

1. Below CR101 and CR102, add: (NOTE 8).
2. Add the following note:

8. ON EQUIPMENTS WITH ORDER NO. 39187–PP–58, CR101 and CR102 ARE TYPE 1N69A.

BY ORDER OF THE SECRETARIES OF THE ARMY AND THE AIR FORCE:

G. H. DECKER,
General, United States Army,
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GENDEP (2) except Atlanta GENDEP (none)
Sig Sec, GENDEP (5)
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Ft Monmouth (63)
AFIP (1)
WRAMC (1)
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USAEPG (2)
EMC (1)
USACA (2)
USASEA (1)
USA Caribbean Sig Agcy (1)
USA Sig Msl Spt Agcy (12)
USASSA (20)
USASSAMRO (1)
Army Pictorial Cen (2)
USAOMC (3)
USA Trans Tml Comd (1)
Army Tml (1)
POE (1)
OSA (1)
AMS (1)
Sig Fld Maint Shops (2)
JBUSMC (2)
Units organized under following TOE's:

11-7 (2)	11-500 AA-AE (4)
11-16 (2)	
11-57 (2)	11-557 (2)
11-98 (2)	11-587 (2)
11-117 (2)	11-592 (2)
11-155 (2)	11-597 (2)

NG: State AG (3); units—same as Active Army except allowance is one copy to each unit.
USAR: None.
For explanation of abbreviations used, see AR 320-50.

U.S. GOVERNMENT PRINTING OFFICE: 1961

WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

Be careful when working on the 150-volt plate and power supply circuits, or on the 110-volt ac input to the battery charger.

DON'T TAKE CHANCES!

TECHNICAL MANUAL
No. 11-5041
TECHNICAL ORDER
No. 33A1-4-33-1

DEPARTMENTS OF THE ARMY AND
THE AIR FORCE

WASHINGTON 25, D. C., *15 October 1956*

FIELD STRENGTH METER AN/URM-91

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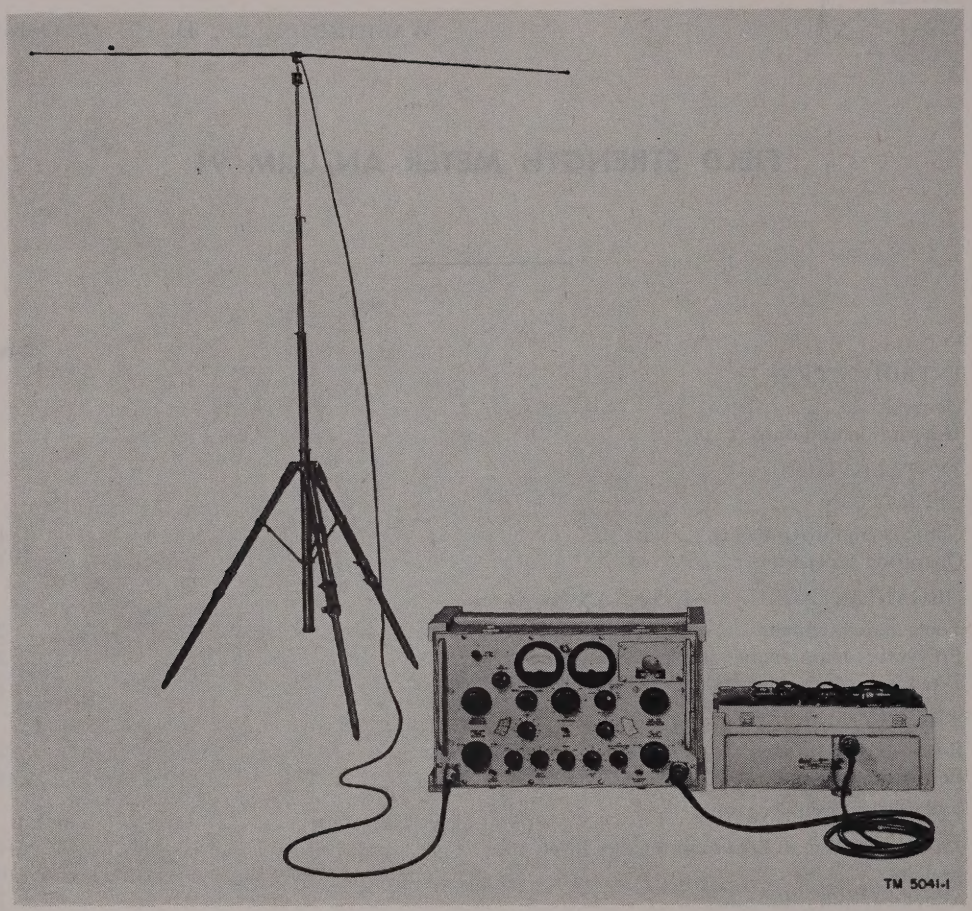


Figure 1. Field Strength Meter AN/URM–91, major components.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual contains instructions for the installation, operation, maintenance, and repair of Field Strength Meter AN/URM–91 (fig. 1).

b. Forward comments on this publication directly to Commanding Officer, The Signal Corps Publications Agency, Fort Monmouth, N. J.

2. Forms and Records

a. Unsatisfactory Equipment Reports. Fill out and forward DA Form 468 (Unsatisfactory Equipment Report) to Commanding Officer, Signal Equipment Support Agency, Fort Monmouth, N. J. as prescribed in AR 700–38.

b. Damaged or Improper Shipment Report. Fill out and forward DD Form 6 (Report of Damaged or Improper Shipment), as prescribed in AR 700–58 (Army); Navy Shipping Guide, Article 1850–4 (Navy); and AFR 71–4 (Air Force).

c. Preventive Maintenance Forms.

(1) Prepare DA Form 11–238 (Operator First Echelon Maintenance Checklist for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar)) in accordance with instructions on the back of the form (fig. 11).

(2) Prepare DA Form 11–239 (Second and Third Echelon Maintenance Checklist for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar)) in accordance with instructions on the back of the form (fig. 12).

Section II. DESCRIPTION AND DATA

3. Purpose and Use

a. Field Strength Meter AN/URM–91 (fig. 1) is a transportable test set designed to measure the radiation field intensities of amplitude-modulated (AM), frequency-modulated (FM), or continuous-wave (cw) transmitting stations operating in the frequency range of 18 to 125 megacycles (mc). It provides either linear or logarithmic output for single field-intensity readings or for use with a recorder to make continuous records of signal intensity variation while the equipment is unattended.

b. The field-strength meter performs the following functions:

(1) Determines reception characteristics, such as signal intensity, fading, and atmospherics, at a site for any period of time.

(2) Measures transmitter coverage.

(3) Measures changes in transmitter or transmitter-antenna characteristics.

(4) Measures spurious radiation.

4. Technical Characteristics

a. Field Strength Meter IM–117/URM–91.

Receiver type	Superheterodyne.
Frequency bands	18 to 35 mc. 33 to 66 mc. 62 to 125 mc.
Types of signals received and measured	AM, FM, and cw.
Number of tubes	10.
Intermediate frequency	10.7 mc.
Method of calibration	Internal calibration oscillator.

Outputs ..... Direct-reading meter calibrated in microvolts and decibels, recorder jack, and audio (headset) jack.

Accuracy of frequency calibration ..... ±2%.

Accuracy of field-strength measurements ..... ±2 db.

Field-strength range (sharp response):

Low-frequency end ..... 5 to 50,000 microvolts per meter.

High-frequency end ..... 10 to 50,000 microvolts per meter.

Bias supply ..... Two batteries BA–34 (not supplied with equipment).

Power requirements ..... 185 v dc at 65 ma and 6 v dc at 2 amp.

b. Power Supply PP–1642/URM–91.

Power input requirements ..... 110 v ac, 60 cy for battery charger.

Power outputs ..... 185 v dc; 6 v dc.

Operating time on full charge ..... 6 hr.

c. Antenna AS–802/URM–91.

Type ..... Dipole, adjustable for frequency range 18 mc to 125 mc.

Orientation ..... Vertical or horizontal.

Dipole elements ..... 12 fixed sections and 2 telescoping sections.

Mounting ..... Tripod with telescoping mast sections for height adjustment.

5. Common Names Versus Nomenclature

A list of nomenclature assignments for the components of Field Strength Meter AN/URM–91 and the batteries used with it is given below. A common name is indicated after each item.

Nomenclature	Common name
Field Strength Meter AN/URM–91	Field-strength meter.
Antenna AS–802/URM–91	Antenna.
Antenna Case CY–1911/URM–91	Antenna case.
Cotton Duck Bag CW–398/URM–91	Tripod storage bag.
Battery BB–242/U	Storage battery.
Battery BA–34	Bias battery.
Cord CD–307A	Power cord.
Field Strength Meter IM–117/URM–91	Receiver.
Headset Assembly U. S. Navy Type CW–49507A.	Headset.
Power Supply PP–1642/URM–91	Power supply.
Impedance Matching Network CU–504/URM–91.	Impedance-matching network.

6. Components

a. Table of Components.

Component	Required No.	Height (in.)	Depth (in.)	Width (in.)	Unit weight (lb)
Field Strength Meter IM–117/URM–91	1	13½	13	19⅞	41
Power Supply PP–1642/URM–91	1	8¼	9	16	43
Cord CD–307A (8′ 0″ lg)	1				1
External power cord	1				.75
Headset assembly, U. S. Navy Type CW–49507A	1	5¼	3½	6	.6
Antenna AS–802/URM–91 consisting of:	1				50
Antenna Element AB–21/GR	12				
Antenna element, telescoping	2				
Steel megacycle rule	1				
Cotton duck bag (antenna element storage)	1				
Antenna mounting head	1				
Antenna cable	1				
Antenna Case CY–1911/URM–91	1	9½	11¼	40¼	
Cotton Duck Bag CW–398/URM–91	1				
Impedance Matching Network CU–504/URM–91	1				.3
Set of running spares (*b* below)	1	3½	2½	5¼	.3
Manual	2	¼	7⅞	10¼	1
Total					138.41

Note. This list is for general information only. See SIG 7 & 8 AN/URM–91 for information pertaining to the requisitioning of spare parts. Refer to paragraph 8 for additional equipment required but not supplied.

b. Running Spares. Following is a list of running spares for the field-strength meter. These items are stored inside the receiver carrying case.

1 tube 0A2.
1 tube 6BF6.
2 tubes 6BJ6.
1 tube 6BQ7.
1 tube 6C4.
1 tube 12AT7.

Note. This list is for general information only. See appropriate supply publications for information pertaining to allowable spare parts.

7. Description of Components

a. Field Strength Meter IM–117/URM–91 (fig. 2) is a transportable receiver housed in a carrying case; the cover is removed by unfastening four trunk latches found on opposite sides of the case. All operating controls are on the front panel and are easily reached when the cover is removed. The antenna and power input connectors are also on the front panel.

b. Power Supply PP–1642/URM–91 (fig. 3) provides space for four storage batteries. Connectors and breather tubes for the storage batteries are packed in the power-supply case. The cover of the case is held in place by four trunk latches. One side of the case is fitted with transparent openings through which the storage-battery electrolyte level and charge indicators may be seen (fig. 4). Three coiled power cords are packed in a compartment in one end of the case. The controls are mounted on the horizontal panel.

c. Antenna AS–802/URM–91 (fig. 5) is a tripod-mounted dipole. The dipole length is adjustable, so that it may be tuned within the frequency range of the receiver. A mounting head permits rotating the dipole in the horizontal and vertical planes, to allow orientation for transmitter direction and signal polarization. All parts of the antenna are packed in a metal case.

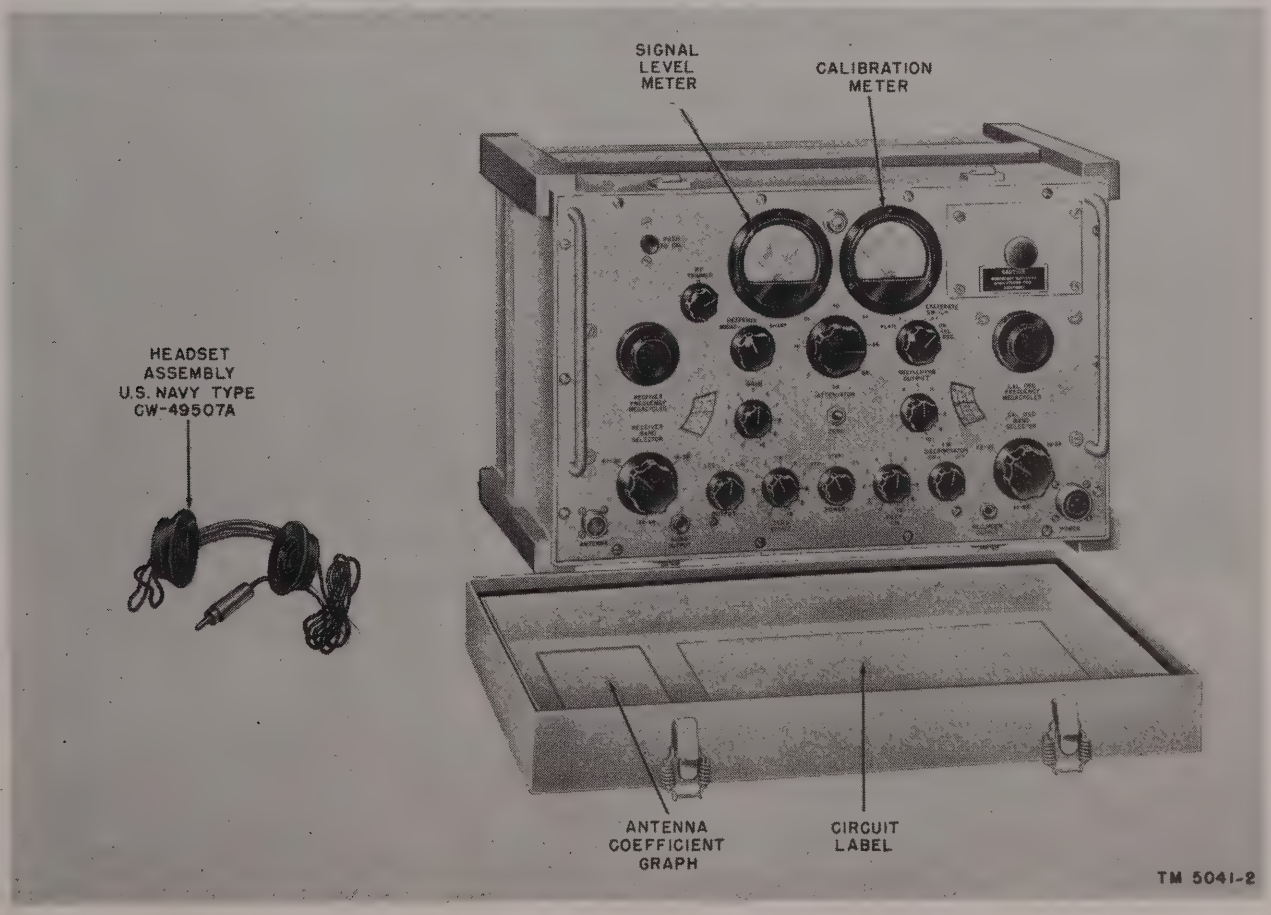


Figure 2. Field-Strength Meter IM–117/URM–91, with headset.

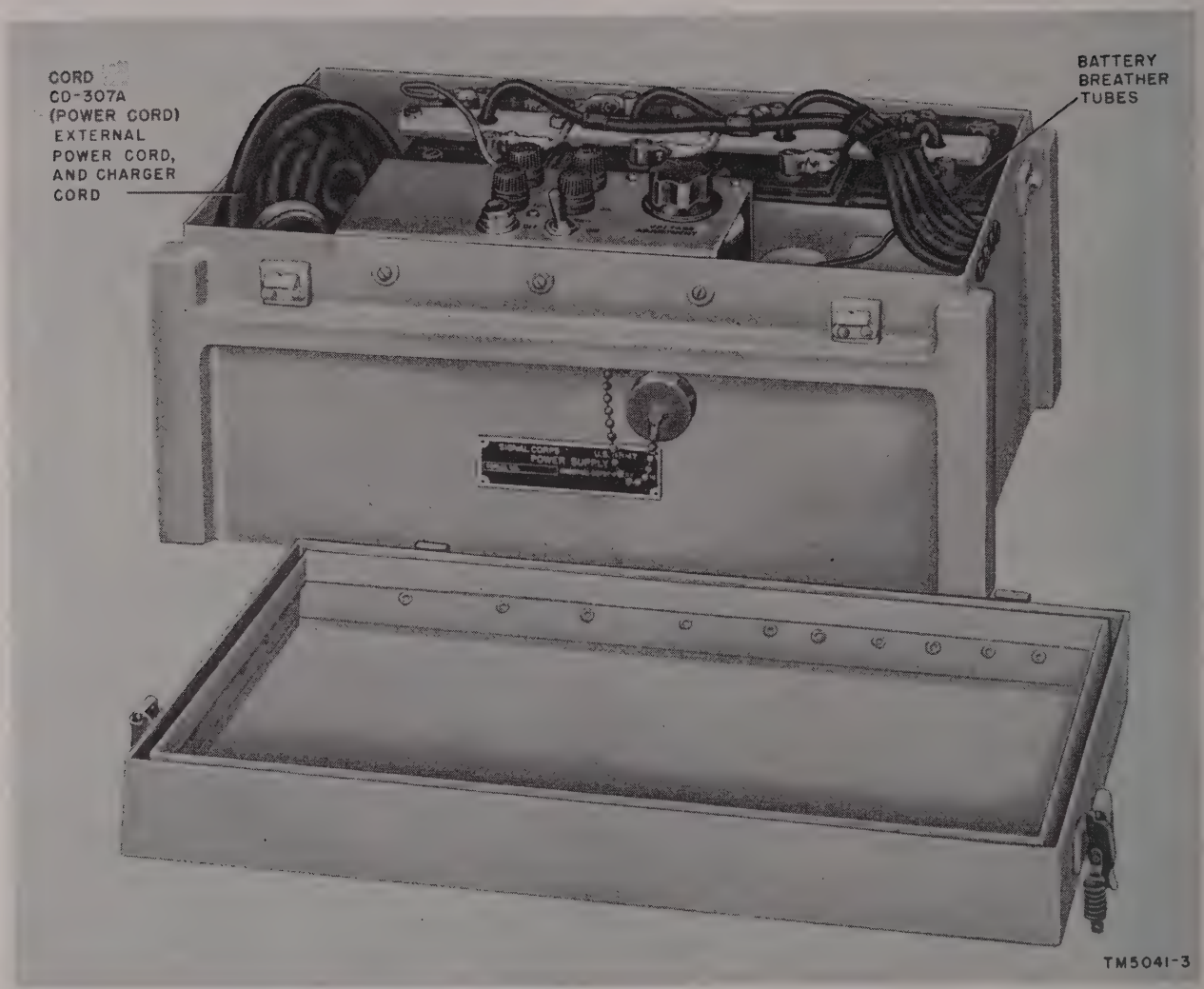


Figure 3. Power Supply PP–1642/URM–91, front oblique view.

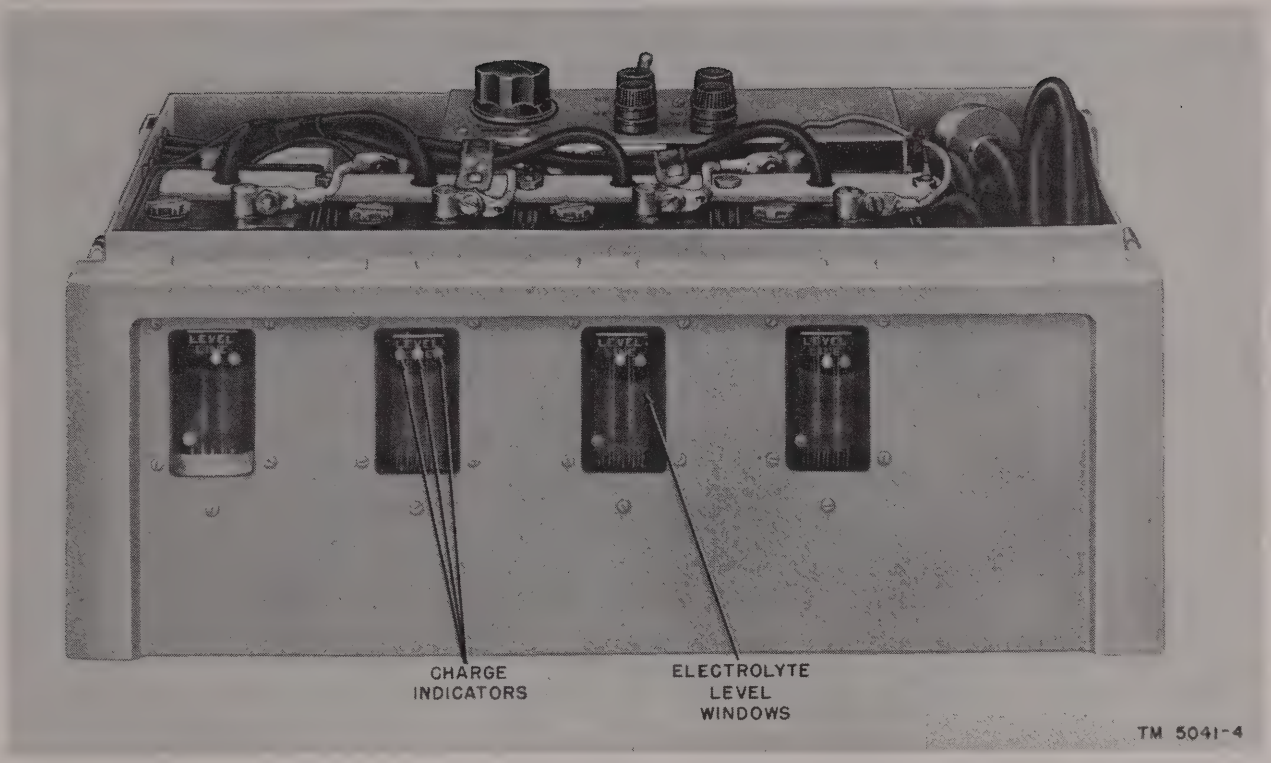


Figure 4. Power Supply PP-1642/URM-91, rear oblique view.

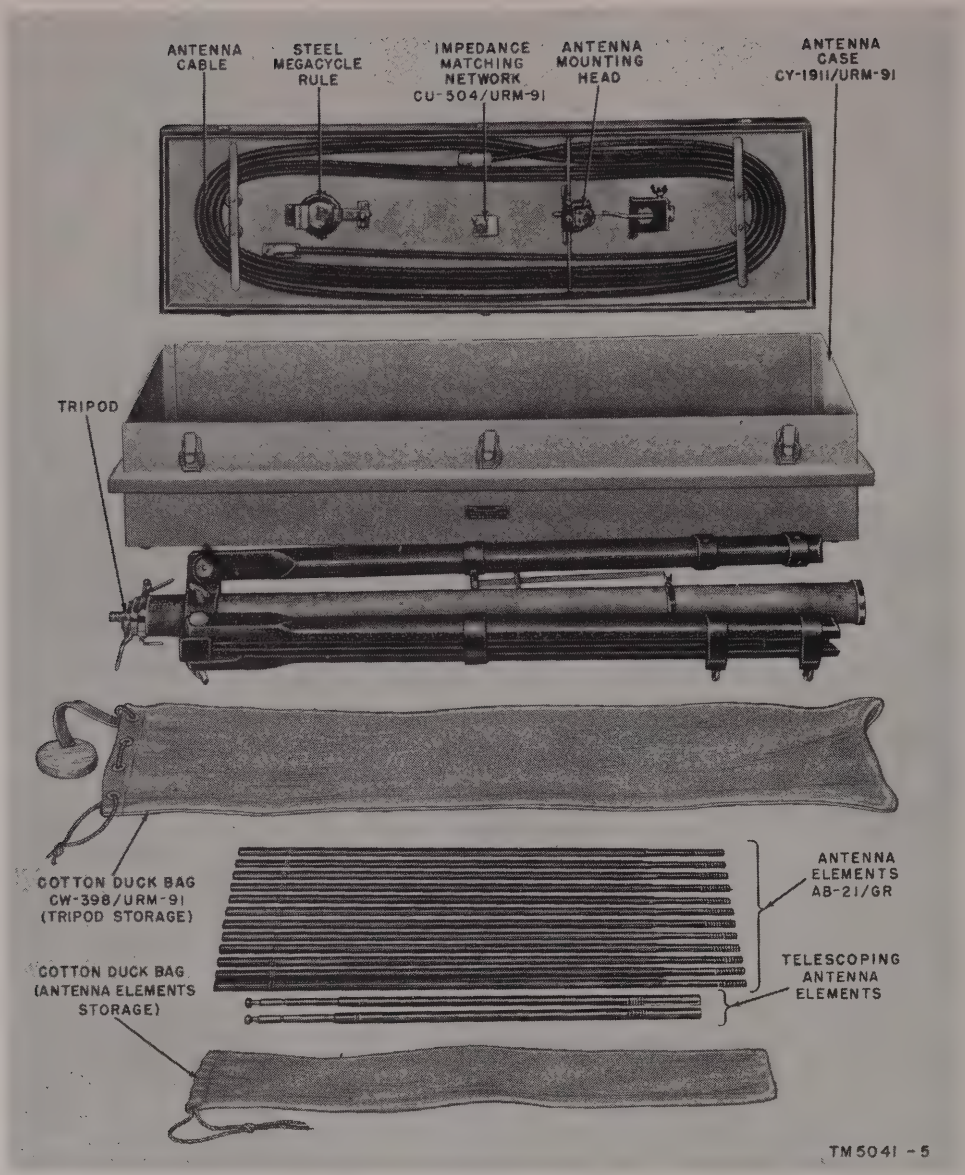


Figure 5. Antenna AS–802/URM–91 and accessories.

8. Additional Equipment Required

a. The following equipment is not supplied with the field-strength meter but is required for its operation:

4 Batteries BB–242/U.

2 Batteries BA–34.

b. No other equipment is normally required; however, if continuous recording of field-strength indications is intended, a suitable recording instrument may be connected to the receiver by means of the RECORDER OUTPUT jack. The input impedance of the recording instrument should be 560 to 600 ohms.

CHAPTER 2

INSTALLATION

9. Unpacking

a. Packaging Data. When packed for shipment, the components are placed in moisture-vaporproof containers and packed in three wooden boxes. A typical shipping box and its contents are shown in figure 6. The dimensions and contents are as follows:

Box No.	Height (in.)	Width (in.)	Depth (in.)	Volume (cu ft)	Unit weight (lb)	Contents
1 of 3	17½	24	17	3.12	61	Receiver.
2 of 3	12	20	13	1.81	63	Power supply.
3 of 3	13½	44	15½	5.3	70	Antenna.
Total weight					194	

b. Removing Contents. When unpacking equipment, perform the procedure outlined below.

(1) Cut and fold back the metal straps.
(2) Remove the nails from the top and one side of the box with a nail puller. Remove the top and side. Do not attempt to pry off the top and side; the equipment may become damaged.
(3) Remove the fiberboard outer carton from the box.
(4) Open the outer carton and remove the inner carton, which is wrapped in a waterproof barrier.
(5) Open the waterproof barrier and remove the inner carton.
(6) Open the inner fiberboard carton.
(7) Remove the equipment from the inner fiberboard carton and remove the desiccant bags that are packed against the carrying case.
(8) Remove the envelope that contains the manuals.

10. Checking Unpacked Equipment

a. Inspect the equipment for damage incurred during shipment.

b. Check to see that the equipment is complete as shown on the packing list or in the table of components (par. 6).

c. If the equipment is incomplete or damaged, refer to paragraph 2*b*.

d. If the equipment has been used or reconditioned, check to see whether it has been changed by a modification work order (MWO). If modified, the MWO number will appear on the front panel. Indicate the MWO number on the schematic diagram (fig. 38).

e. Check the fuses on the power-supply control panel (fig. 9) for rated values and for placement in the correct fuse holders.

Fuse	Rating	Component	Circuit
Fuse F101	10 amp	Power supply	6-volt filament line.
Fuse F102	2 amp	Power supply	Battery charger 110-volt ac line.

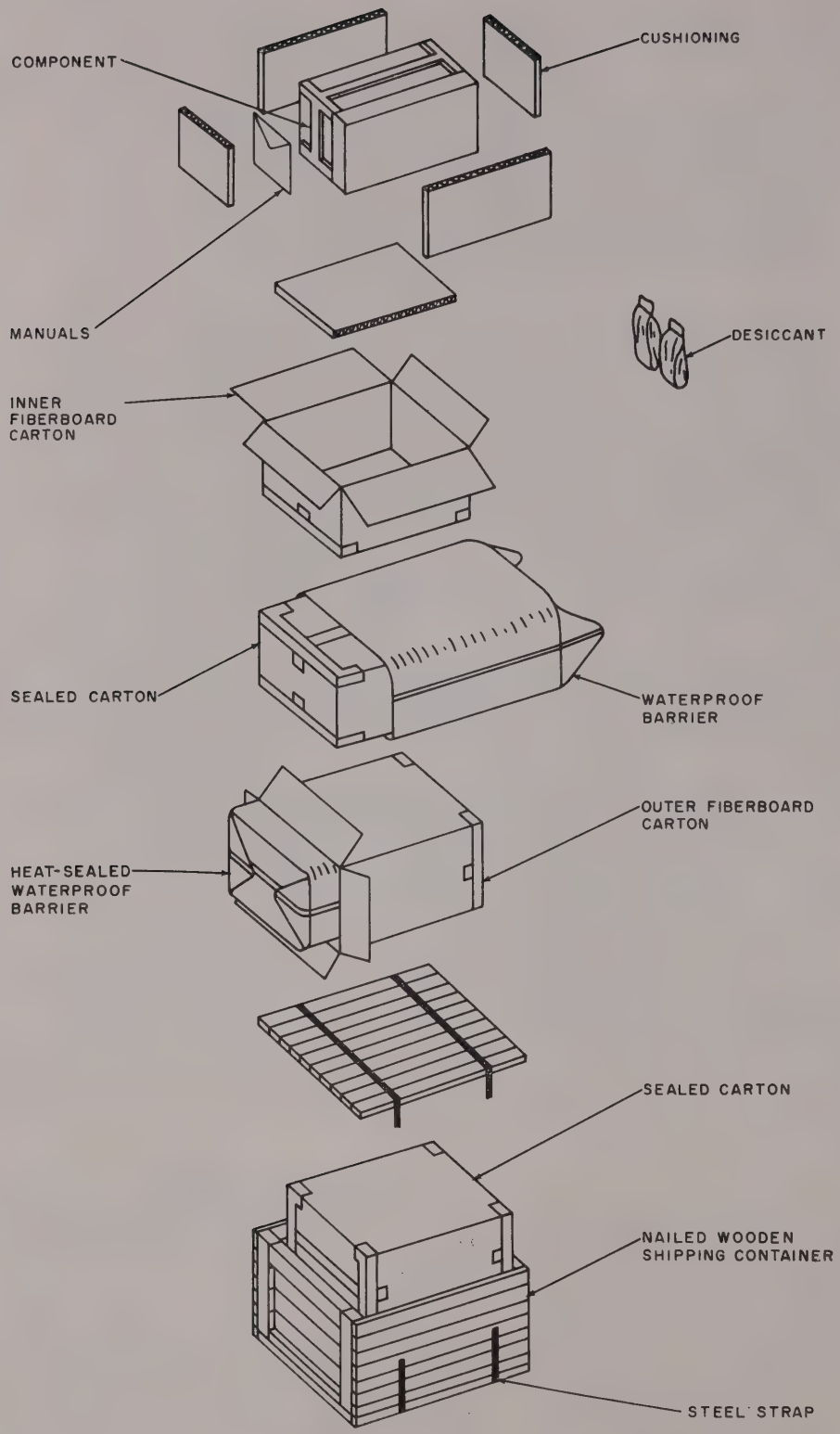
Caution: To avoid damage to the equipment, do not use fuses with ratings other than those specified.

11. Assembly of Antenna

a. After selecting the antenna site, open the antenna case (fig. 5) by releasing the six trunk latches. Unfasten the web straps and remove the tripod.

b. Hold the tripod vertically, loosen the thumbscrews on the legs and lengthen the legs equally for flat ground, or unequally, as required, for sloping ground. Spread the legs until the tripod rests securely on the ground.

c. Remove the antenna mounting head from its clip in the carrying case cover, place it on the mast, and secure it by tightening the thumbscrew.



TM 5041-6

Figure 6. Typical packaging diagram.

d. Remove the antenna elements from their protective bag and remove the steel megacycle rule (fig. 5) from its storage clamp.

Note. Keep sand and mud from the antenna elements.

e. With the steel megacycle rule, note the required length of each dipole half for the frequency to be received. On the mounting stubs of the antenna mounting head, screw sufficient fixed elements and the telescoping sections to approximate the required length. With the steel rule attached to the mounting head eyelet, adjust each telescoping section to the exact length indicated on the rule for the frequency to be received.

f. Connect the antenna cable to the antenna mounting head connector.

g. Loosen the tripod-mast thumbscrews, raise the mast sections, and tighten the thumbscrews. Orient the antenna according to the polarization of the transmitting antenna from which a signal is to be received.

(1) If the transmitting antenna is vertically polarized, turn the antenna mounting head so that the dipole is in a vertical position.

(2) If the transmitting antenna is horizontally polarized, turn the antenna mounting head so that the dipole is in a horizontal position broadside to the general direction from which the signal will be received.

12. Connections

a. Receiver and Power Supply. The receiver and the power supply are ready for connections after removal of their carrying-case covers. Remove these covers by releasing the trunk latches on the sides of the cases. Be sure to set up the power supply with its open top up. Placing it on a side will prevent the escape of electrolyte fumes. If necessary, the receiver may be operated when placed on an end. After starting operations, the power-supply cover may be replaced and secured.

(1) Be sure that the POWER switch on the receiver is in the OFF position.

(2) Connect the power cord, stored in the power-supply case, between the connector on the front of the power-supply case and the POWER connector on the front panel of the receiver (fig. 1).

b. Storage Batteries. The power supply requires the installation and connection of the storage batteries.

(1) Remove the four nuts that fasten the battery mounting strap (fig. 32).

(2) Install four Batteries BB–242/U as shown in figure 9.

(3) Replace the battery mounting strap and the four nuts to secure the batteries in the compartment.

(4) Interconnect the batteries as shown in figure 9; use the battery jumper cords that are stored in the power-supply case.

(5) Loosen the two cable brackets that are fastened on the battery mounting strap (fig. 32). Insert one end of each battery breather tube into a hole in the battery mounting strap; insert the other end of each tube into a grommeted hole in the end of the case. Tighten the cable clamps and tape the battery breather tubes as shown in figure 32.

(6) Check the storage batteries for condition of charge as described in paragraph 26*b*(3). If charging is necessary, plug the charger cord into a source of 115 volts, 60 cycles, until the batteries are fully charged.

c. External Batteries. If external batteries are used instead of the power supply, connect one end of the external power cord to the POWER connector on the front panel of the receiver. At the other end of the cord, connect the A+ red lead and the A— black lead to the positive and negative terminals, respectively, of a 6-volt battery. Connect the B+ red lead and the B— black lead to the positive and negative terminals, respectively, of a 150-volt battery.

d. Antenna. Connect the antenna cable to the ANTENNA connector on the front panel of the receiver.

e. Bias Batteries. Remove the bias-battery cover on the upper right corner of the receiver control panel by unfastening the four captive screws. Install two bias batteries in the mounting clips, and connect them to the terminal strip (fig. 7). Cut the battery wires and tape the ends. Be sure that the plus ends of the batteries are placed at the plus end of the terminal strip. Install the connected batteries in the compartment with the terminals facing

the insulating plate, and fasten the coverplate by tightening the captive screws.

f. Audio Outputs. Plug the headset into the AUDIO OUTPUT jack on the front panel of the receiver. If a recorder is used, plug it into the RECORDER OUTPUT jack.

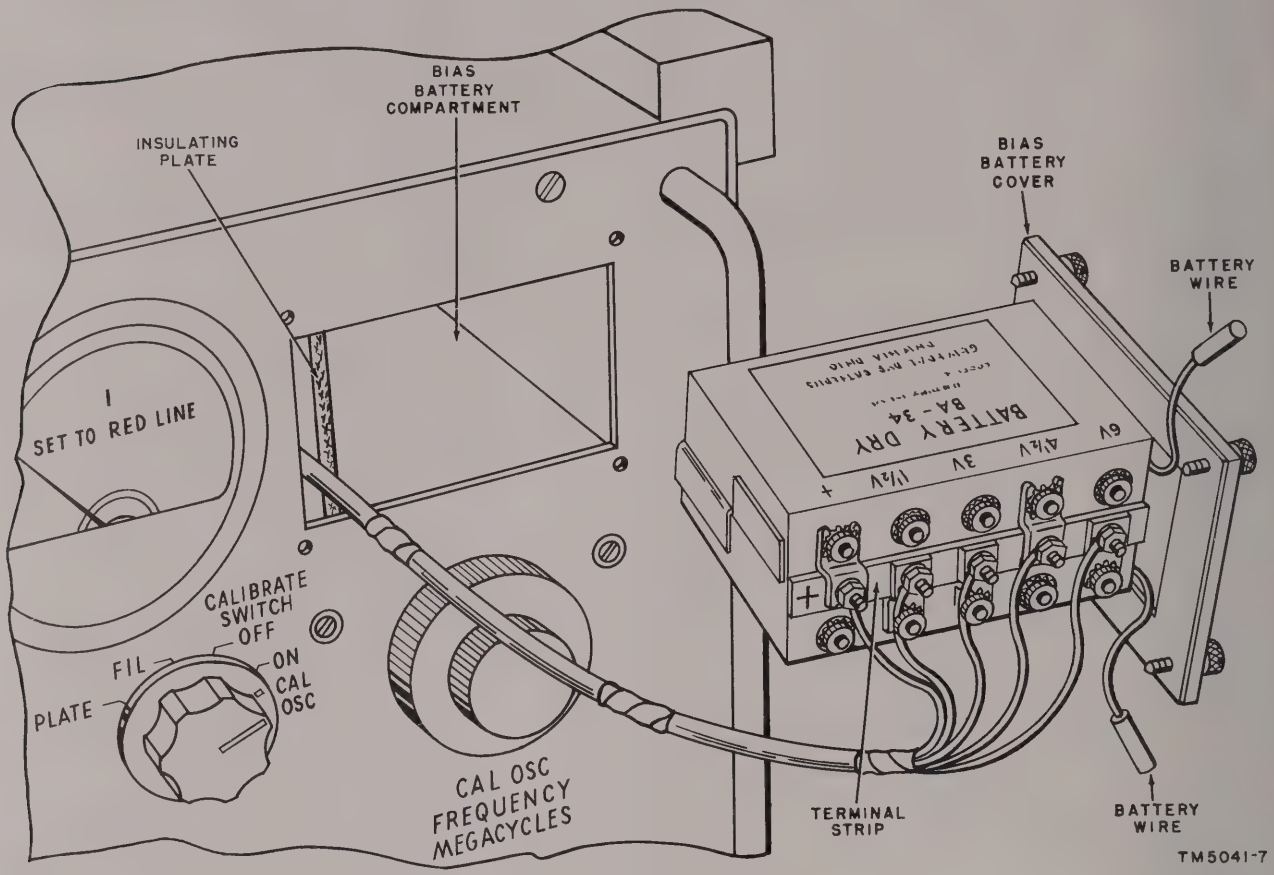


Figure 7. Installation of bias batteries.

CHAPTER 3

OPERATION

Section I. CONTROLS AND INSTRUMENTS

13. General

It is important to know the function of every control and meter on the equipment to prevent incorrect operation and misleading indications. The actual operating instructions are contained in paragraphs 15 through 19.

14. Controls and Their Uses

a. Receiver. The following chart lists the controls and meters of the receiver (fig. 8) and the purpose of each.

Control	Function
POWER switch	In START and ON positions, turns on the receiver and the vibrator power supply. Used in START position for zeroing signal level meter with ZERO START control. Used in ON position for normal operation of the equipment.
CALIBRATE SWITCH	In PLATE and FIL positions, permits adjustment of plate and filament voltage from power supply. In ON CAL OSC position, turns on calibrating oscillator.
ZERO switch	In down position, permits zeroing of the signal level meter.
ZERO START control	Zeros the signal level meter when the POWER switch is in START position.
ZERO ON control	Zeros the signal level meter when the POWER switch is in ON position.
RESPONSE switch	Selects BROAD or SHARP if bandwidth. BROAD position is used in searching for a signal. SHARP position is used for normal operation.
OUTPUT switch	In LIN position, gives linear indications on signal level meter. In LOG position, gives logarithmic indications on signal level meter.
ATTENUATOR control	Controls attenuation of signals in steps of 14, 26, 40, 54, 66, and 80 db. Permits measurement of signals in wide range of intensity.
RECEIVER FREQUENCY control.	Outer knob fast-tunes receiver; inner knob fine-tunes receiver to desired frequency as shown on MEGACYCLES dial.
RF TRIMMER control	Permits peaking of received signal at any frequency.
RECEIVER BAND SELECTOR switch.	Selects 18–35 mc, 33–66 mc, or 62–125 mc receiver frequency bands.
CAL OSC FREQUENCY control.	Outer knob fast-tunes calibrating oscillator; inner knob fine-tunes calibrating oscillator to match receiver frequency as shown on MEGACYCLES dial.
CAL OSC BAND SELECTOR switch.	Selects 18–35 mc, 33–66 mc, or 62–125 mc frequency bands in calibrating oscillator to match receiver frequency.
PUSH TO CAL. switch	Disconnects antenna and applies calibrating-oscillator output to receiver to calibrate receiver gain.
GAIN control	Adjusts receiver gain.
OSCILLATOR OUTPUT control.	Adjusts calibrating-oscillator output voltage.
FM DISCRIMINATOR switch	In ON position, permits reception of FM signals. In OFF position, permits reception of AM signals.
Panel light	Lights when POWER switch is in START or ON position.
Calibration meter	Indicates correct plate voltage, filament voltage, and calibrating-oscillator output when needle rests at red line and CALIBRATE SWITCH knob is in proper position.
Signal level meter	Indicates signal intensity for field-strength measurement. Read the lower, black scale when OUTPUT switch is in LIN position. Read the upper, red scale when OUTPUT switch is in LOG position. Also used in calibrating receiver gain and for indicating peaked signal during tuning.

b. Power Supply. The following chart lists the controls of the power supply (fig. 9) and the purpose of each.

Control	Function
CHARGER switch	In ON position, turns on the battery charger.
Panel light	Lights when battery charger is turned on.
VOLTAGE ADJUSTMENT control.	Permits adjustment of filament voltage to receiver.

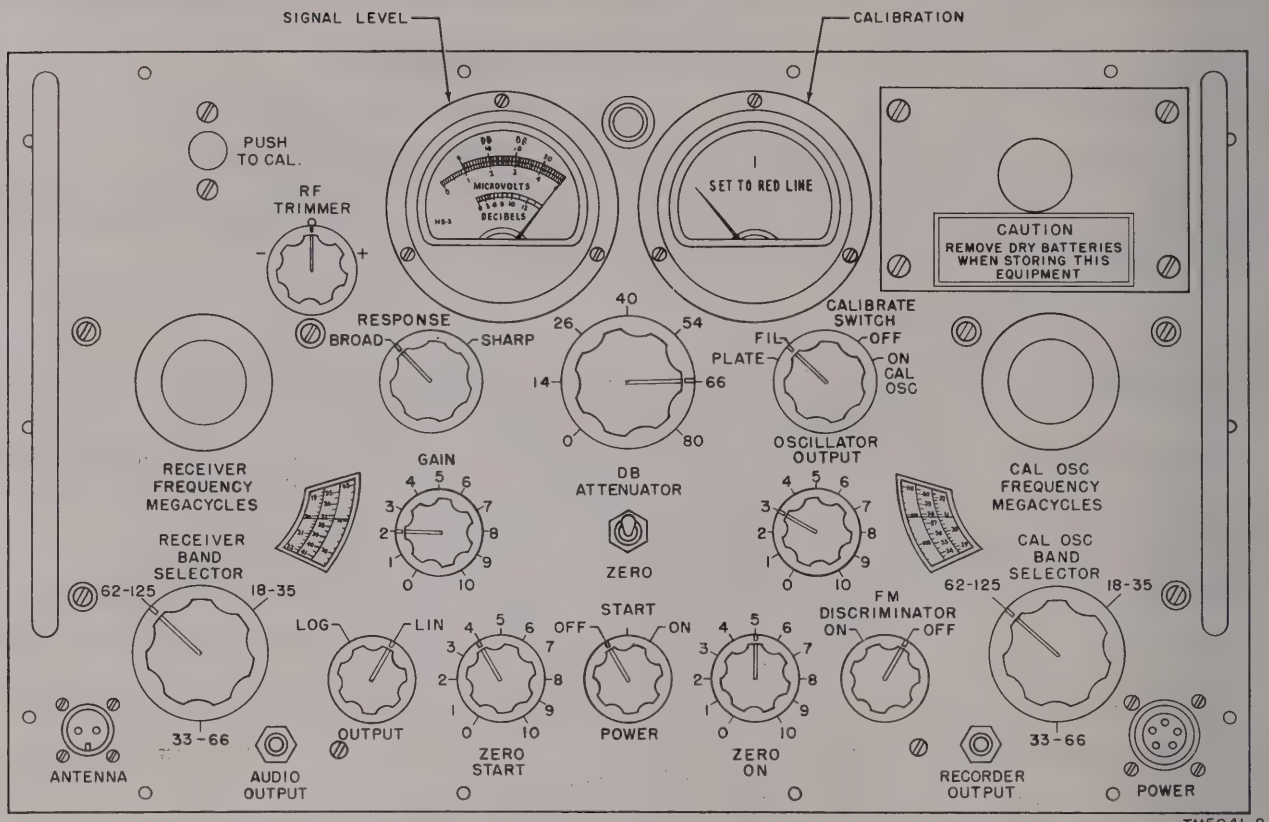


Figure 8. Field-Strength Meter IM–117/URM–91, controls and instruments.

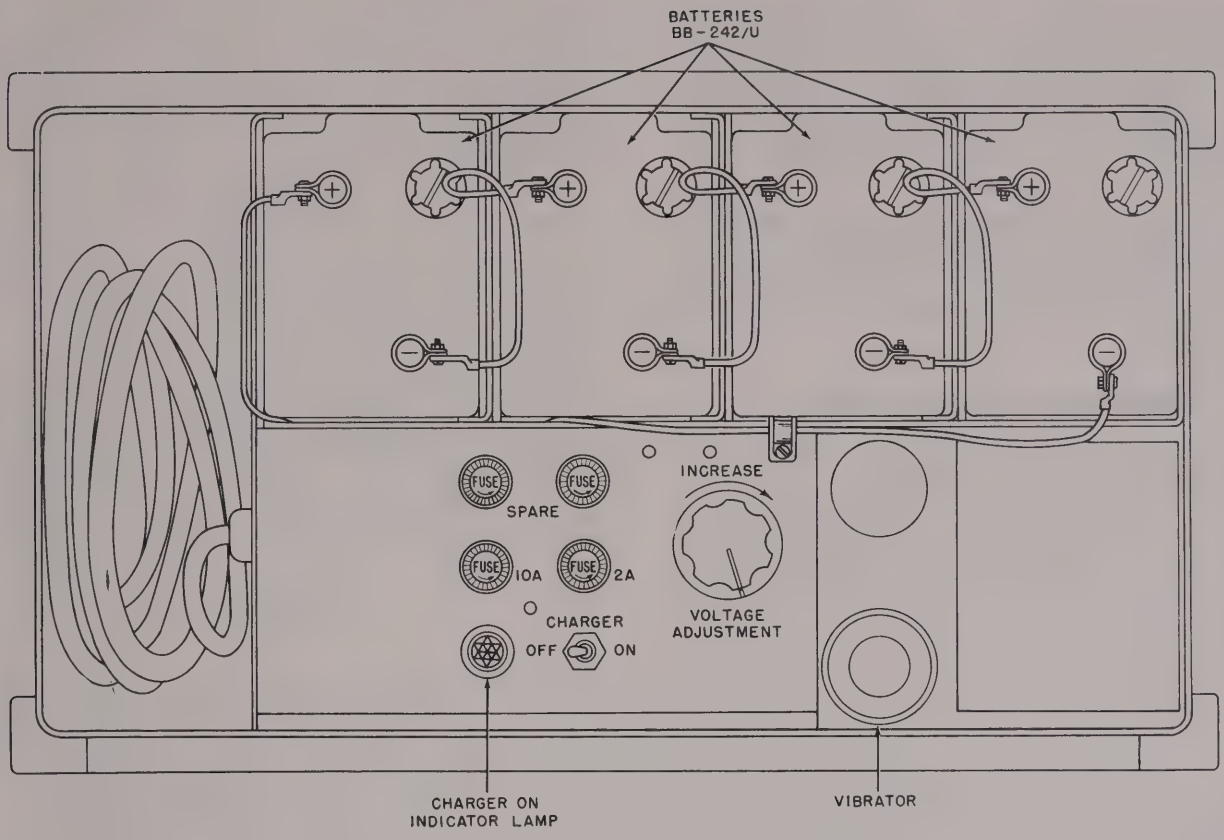


Figure 9. Power Supply PP–1642/URM–91, controls.

Section II. OPERATING PROCEDURES

15. Location for Best Operation

Before making measurements or recordings, test the site for noise and interference. Use the headset and listen for unwanted signals while the receiver is tuned to the frequency at which the measurements are to be made. If such signals and/or noise is present, misleading results will be obtained. Meter and recorder indications will be inaccurate, because the unwanted signals will affect them, and because the sensitivity of the receiver will be reduced.

a. If the location is not quiet, either wait until the interference stops or select another site.

b. The location selected may be quiet at the time of test, but if a continuous recording is to be made, consideration should be given to the possibility of later interference.

c. Do not set up the equipment near radar sets, power lines, and sources of ignition interference.

16. Starting Procedure

Perform the starting operations outlined in *a* through *e* below before using the operating procedures described in paragraphs 17 and 18.

a. Turn the POWER switch to the START position and allow 1 minute for warmup.

b. Turn the CALIBRATE SWITCH to the FIL position. Rotate the VOLTAGE ADJUSTMENT control on the power supply until the calibration meter needle rests on the red line.

c. Turn the CALIBRATE SWITCH to the PLATE position. The calibration meter needle should again rest on the red line.

d. Perform the procedures in *b* and *c* above periodically during operation to assure correct filament and plate-supply voltages.

Note. When external batteries are used instead of the power supply, the needle on the calibration meter may not rise to the red line, especially if the batteries are not new.

e. Push the ZERO switch down and adjust the ZERO START control until the signal level

meter reads zero on the MICROVOLTS scale. Turn the POWER switch to the ON position, with the ZERO switch held down, and adjust the ZERO ON control until the signal level meter again reads zero on the MICROVOLTS scale.

f. If a recorder is to be used, it should be plugged into the RECORDER OUTPUT jack. The adjustment of the ZERO ON control (*e* above) must be made with the recorder plugged in.

17. Calibration of Receiver Gain

Procedures for calibrating the gain of the receiver so that signal intensity values can be read directly on the signal level meter (fig. 8) during the field-strength measurement operation (par. 18) are given in *a* through *f* below. *The calibration is accurate only at the frequency at which it is made.* Use of another frequency requires calibration of receiver gain.

a. Set the front panel controls as follows:

Control	Setting
CALIBRATE SWITCH	OFF.
RESPONSE switch	BROAD.
OUTPUT switch	LIN.
OSCILLATOR OUTPUT control	0.
FM DISCRIMINATOR switch	OFF for AM signals. ON for FM signals.
ATTENUATOR control	0 or 14.

b. Set the RECEIVER BAND SELECTOR and the CAL OSC BAND SELECTOR to the correct band for the desired frequency. Tune the RECEIVER FREQUENCY control to the desired frequency until the signal can be heard in the headset. Rotate the antenna dipole to the exact position that produces the strongest reception. Adjust the RF TRIMMER control for a maximum reading on the signal level meter. For very strong signals, change the ATTENUATOR control to a higher setting to produce an on-scale meter reading.

Note. Most transmitter antennas are polarized horizontally, and the antenna dipole is therefore normally oriented horizontally. If no signal is received after rotation of the dipole, with the ATTENUATOR control at the O setting, orient the dipole to a vertical position.

c. Reset the front panel controls as follows:

Control	Setting
CALIBRATE SWITCH	ON CAL OSC.
RESPONSE switch	SHARP.
FM DISCRIMINATOR switch	OFF.
ATTENUATOR control	66.

d. Tune the CAL OSC FREQUENCY control to the receiver frequency. Adjust the OSCILLATOR OUTPUT control until the calibration meter needle rests on the red line.

e. Press and hold in the PUSH TO CAL. switch. Fine-tune the CAL OSC FREQUENCY control for a maximum reading on the signal level meter. Readjust the RF TRIMMER control for a maximum reading on the signal level meter. Adjust the GAIN control for a full-scale deflection of 14 decibels (db), as read on the lower (black) DECIBELS scale of the signal level meter. Release the PUSH TO CAL. switch.

f. Leave the GAIN control at its calibrated setting throughout field-strength measurements made at the first frequency. If a signal of different frequency is to be measured, the calibration procedure in a *through* e *above must be performed again.*

18. Measurement of Field Strength

Perform the field-strength measurement described in *a* through *g* below only after calibration of the receiver gain (par. 17).

a. Turn the CALIBRATE SWITCH to the OFF position. This is important because proper indications cannot be obtained when the switch is in the ON CAL OSC position; however, the PLATE and FIL positions may be used to check power-supply voltages during operation.

b. If the received signal is strong, signal intensity can be read with the ATTENUATOR control at the 66 position. If the received signal is weak, reset the ATTENUATOR control to a lower attenuation value until the signal level meter reads on-scale.

c. Adjust the RF TRIMMER control for maximum meter reading.

d. With the OUTPUT switch in the LIN position, read the signal intensity on the lower (black) DECIBELS scale.

e. Determine the antenna coefficient for the received frequency from the K factor graph (fig. 10) on the inside of the receiver carrying-case cover.

f. Apply the obtained data to the following field-strength formula:

$$FS=S+A+K$$

where: FS=Field strength in db above 1 microvolt per meter.
S =Signal level meter reading in db.
A =ATTENUATOR control setting.
K =K factor for received frequency.

g. If a recorder is to be used for continuous field-strength readings, turn the OUTPUT switch to the LOG position. Indications on the signal level meter are then read on the upper (red) DB scale.

19. Stopping Procedure

a. Turn the GAIN and OSCILLATOR OUTPUT controls to O.

b. Turn the POWER switch to the OFF position.

c. Disconnect the power cord, the antenna cord, the headset, and the recording instrument, if used.

d. Replace the receiver carrying-case cover. Coil the power cord, store it in its compartment, and replace the power-supply carrying-case cover.

e. Disassemble and store all antenna components if the equipment is to be moved to a new location.

f. As soon as possible after each period of operation, connect the power-supply charger cord to a source of 110 volts ac, 60 cycles. Turn the CHARGER switch to ON to recharge the storage batteries. The batteries are fully charged when all three charge indicators (fig. 4) are floating at the top of the electrolyte.

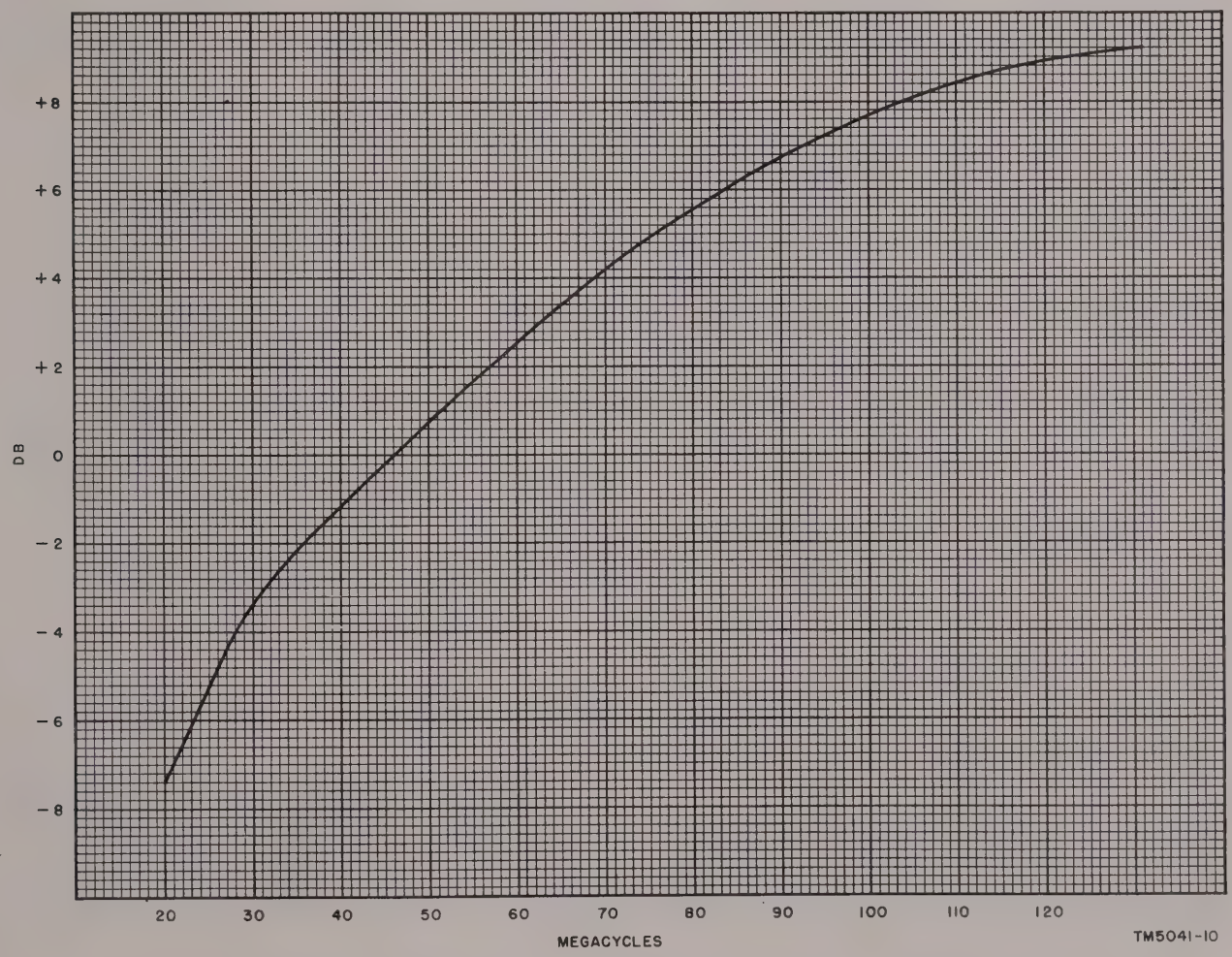


Figure 10. Graph of antenna coefficient (K), in db, versus frequency.

CHAPTER 4

ORGANIZATIONAL MAINTENANCE

Section I. TOOLS AND EQUIPMENT

20. Tools and Materials Required

The following tools, materials, and test equipment are required for organizational maintenance procedures:

a. Tools.

Tool Equipment TE–41.

b. Materials.

Cheesecloth, bleached, lint-free*.

Sandpaper, flint No. 000*.

Cleaning Compound (Federal stock No. 7930–395–9542).

21. Test Equipment Required

The test equipment required for organizational maintenance is listed below. A common name is indicated after each component.

Nomenclature	*Common name*
Electron Tube Test Set TV–7/U	Tube tester
Multimeter TS–352/U	Multimeter

Section II. PREVENTIVE MAINTENANCE SERVICES

22. Definition of Preventive Maintenance

Preventive maintenance is work performed on equipment (usually when the equipment is not in use) to keep it in good working order, so that breakdowns and needless interruptions will be kept to a minimum. Preventive maintenance differs from troubleshooting and repair in that its object is to prevent trouble.

23. General Preventive Maintenance Techniques

a. Use No. 000 sandpaper to remove corrosion.

b. Use a clean, dry cheesecloth or a dry brush for cleaning. If necessary, clean the parts, including electrical contacts, with cheesecloth moistened with cleaning compound; wipe the parts dry with cheesecloth.

Caution: Prolonged breathing of cleaning compound fumes is dangerous. Provide adequate ventilation. Cleaning compound is flammable; do not use it near a flame.

* Part of tool equipment TE–41.

24. Use of First Echelon Preventive Maintenance Form (fig. 11)

a. DA Form 11–238 is a preventive maintenance checklist to be used by the operator.

b. Items not applicable to the field-strength meter are lined out on figure 11. References in the ITEM block in the figure are to paragraphs in this manual that contain additional maintenance information pertinent to the particular item.

25. Use of Second Echelon Preventive Maintenance Form (fig. 12)

a. DA Form 11–239 is a preventive maintenance checklist to be used by the second echelon repairman.

b. Items not applicable to the field-strength meter are lined out on figure 12. References in the ITEM block in the figure are to paragraphs in this manual that contain additional maintenance information pertinent to the particular item.

OPERATOR FIRST ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT

RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE	EQUIPMENT SERIAL NO.
FIELD STRENGTH METER AN/URM-91	17

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; Ⓧ Defect corrected.
NOTE: Strike out items not applicable.

DAILY

NO.	ITEM	CONDITION S	M	T	W	T	F	S
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT (*receiver, ~~transmitter~~, carrying cases, ~~wire and~~ cable, ~~microphones, tubes~~, spare parts, technical manuals and accessories*). PAR 26a(1)							
2	LOCATION ~~AND INSTALLATION~~ SUITABLE FOR NORMAL OPERATION. PAR 15							
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, ~~MICROPHONE,~~ HEADSETS, ~~CHESTSETS, KEYS,~~ JACKS, PLUGS, ~~TELEPHONES,~~ CARRYING BAGS, ~~COMPONENT PANELS.~~ PAR 23							
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: ~~TUBES, LAMPS, CRYSTALS,~~ FUSES, CONNECTORS, VIBRATORS, ~~PLUG-IN COILS AND RESISTORS.~~ PAR 26a(2)							
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, ~~WORN OR CHIPPED GEARS, MISALIGNMENT,~~ POSITIVE ACTION. PAR 26a(3)							
6	CHECK FOR NORMAL OPERATION. PAR 31							

WEEKLY

NO.	ITEM	CONDITION	NO.	ITEM	CONDITION
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, ~~RACK MOUNTS, SHOCK MOUNTS,~~ ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, ~~WAVE GUIDES,~~ AND CABLE CONNECTIONS. PAR 23		13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES. PAR 26b(3)	
8	INSPECT CASES, ~~MOUNTINGS,~~ ANTENNAS, ~~TOWERS,~~ AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE.		14	CLEAN ~~AIR FILTERS, BRASS NAME PLATES,~~ DIAL AND METER WINDOWS, JEWEL ASSEMBLIES.	
9	INSPECT CORD, CABLE, ~~WIRE, AND SHOCK MOUNTS~~ FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN.		15	INSPECT METERS FOR DAMAGED GLASS AND CASES.	
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS ~~AND REFLECTORS.~~ PAR 26b(1)		16	~~INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHER PROOFING.~~	
11	INSPECT CANVAS ITEMS, ~~LEATHER, AND CABLING~~ FOR MILDEW, TEARS, AND FRAYING.		17	~~CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION.~~	
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ~~ELECTRICAL TRANSFORMERS, POWERSTATS, RELAYS, SELSYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS,~~ AND PILOT LIGHT ASSEMBLIES. PAR 26b(2)		18	~~CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE.~~	

19 IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.

DA 1 MAY 51 FORM 11-238 REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

TM5041-11

Figure 11. DA Form 11-238.

SECOND AND THIRD ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT

RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE: FIELD STRENGTH METER AN/URM-91 | EQUIPMENT SERIAL NO.: 17

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; Ⓧ Defect corrected.
NOTE: Strike out items not applicable.

NO.	ITEM	CONDITION
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT (*receiver, ~~transmitter~~, carrying cases, ~~wire and~~ cable, ~~microphones, tubes~~, spare parts, technical manuals and accessories*). PAR 26a (1)	
2	LOCATION ~~AND INSTALLATION~~ SUITABLE FOR NORMAL OPERATION. PAR 15	
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, ~~MICROPHONE~~, HEADSETS, ~~CHESTSETS, KEYS~~; JACKS, PLUGS, ~~TELEPHONES~~, CARRYING BAGS, ~~COMPONENT PANELS~~. PAR 23	
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: ~~TUBES, LAMPS, CRYSTALS~~, FUSES, CONNECTORS, VIBRATORS, ~~PLUG-IN COILS AND RESISTORS~~. PAR 26a (2)	
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, ~~WORN OR CHIPPED GEARS, MISALIGNMENT~~, POSITIVE ACTION. PAR 26 a (3)	
6	CHECK FOR NORMAL OPERATION. PAR 31	
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, ~~RACK MOUNTS, SHOCK MOUNTS~~, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, ~~WAVE GUIDES~~, AND CABLE CONNECTIONS. PAR 23	
8	INSPECT CASES, ~~MOUNTINGS~~, ANTENNAS, ~~TOWERS~~, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE.	
9	INSPECT CORD, CABLE, ~~WIRE, AND SHOCK MOUNTS~~ FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN.	
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS ~~AND REFLECTORS~~. PAR 26b (1)	
11	INSPECT CANVAS ITEMS, ~~LEATHER, AND CABLING~~ FOR MILDEW, TEARS, AND FRAYING.	
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ~~ELECTRICAL TRANSFORMERS, POWERSTATS, RELAYS, SLEEVES, WIRING, BLOWERS, CAPACITORS, GENERATORS~~, AND PILOT LIGHT ASSEMBLIES. PAR 26 b (2)	
13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES. PAR 26 b (3)	
14	CLEAN ~~AIR FILTERS, BRASS NAME PLATES~~, DIAL AND METER WINDOWS, JEWEL ASSEMBLIES.	
15	INSPECT METERS FOR DAMAGED GLASS AND CASES.	
16	~~INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHERPROOFING.~~	
17	~~CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION.~~	
18	~~CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE.~~	
19	~~ELECTRON TUBES - INSPECT FOR LOOSE ENVELOPES, CAP CONNECTORS, BROKEN GASKETS, INSUFFICIENT GASKET SPRING TENSION; CLEAN DUST AND DIRT CAREFULLY; CHECK EMISSION OF RECEIVER-TYPE TUBES.~~	
20	~~INSPECT FILM CUT-OUTS FOR LOOSE PARTS, DIRT, MISALIGNMENT AND CORROSION.~~	
21	INSPECT FIXED CAPACITORS FOR LEAKS, BULGES, AND DISCOLORATION. PAR 26c (2)	
22	~~INSPECT RELAY AND CIRCUIT BREAKER ASSEMBLIES FOR LOOSE MOUNTINGS; BURNED, PITTED, CORRODED CONTACTS; MISALIGNMENT OF CONTACTS AND SPRINGS; INSUFFICIENT SPRING TENSION; BINDING OF PLUNGERS AND HINGE PARTS.~~	
23	INSPECT VARIABLE CAPACITORS FOR DIRT, MOISTURE, MISALIGNMENT OF PLATES, AND LOOSE MOUNTINGS. PAR 26c (3)	
24	INSPECT RESISTORS, BUSHINGS, AND INSULATORS, FOR CRACKS, CHIPPING, BLISTERING, DISCOLORATION AND MOISTURE. PAR 26 c (4)	
25	~~INSPECT TERMINALS OF LARGE FIXED CAPACITORS AND RESISTORS FOR CORROSION, DIRT AND LOOSE CONTACTS.~~	
26	~~CLEAN AND TIGHTEN SWITCHES, TERMINAL BLOCKS, BLOWERS, RELAY CAGES, AND INTERIORS OF CHASSIS AND CABINETS NOT READILY ACCESSIBLE.~~	
27	~~INSPECT TERMINAL BLOCKS FOR LOOSE CONNECTIONS, CRACKS AND BREAKS.~~	
28	~~CHECK SETTINGS OF ADJUSTABLE RELAYS.~~	
29	~~LUBRICATE EQUIPMENT IN ACCORDANCE WITH APPLICABLE DEPARTMENT OF THE ARMY LUBRICATION ORDER.~~	
30	~~INSPECT GENERATORS, AMPLIDYNES, DYNAMOTORS, FOR BRUSH WEAR, SPRING TENSION, ARCING, AND FITTING OF COMMUTATOR.~~	
31	CLEAN AND TIGHTEN CONNECTIONS AND MOUNTINGS FOR TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS.	
32	INSPECT TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS FOR OVERHEATING AND OIL-LEAKAGE. PAR 26c (7)	
33	BEFORE SHIPPING OR STORING - REMOVE BATTERIES. PAR 26c (8)	
34	~~INSPECT CATHODE RAY TUBES FOR BURNT SCREEN SPOTS.~~	
35	INSPECT BATTERIES FOR SHORTS AND DEAD CELLS. PAR 26b (3) AND 26c (10)	
36	~~INSPECT FOR LEAKING WATERPROOF GASKETS, WORN OR LOOSE PARTS.~~	
37	~~MOISTURE AND FUNGIPROOF.~~	
38	IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.	

DA FORM 1 MAY 51 11-239 REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE. 16—04382-1

TM5041-12

Figure 12. DA Form 11-239.

26. Performing Preventive Maintenance

Caution: Tighten screws, bolts, and nuts carefully. Fittings tightened beyond the pressure for which they are designed will become damaged or broken.

a. Daily.

(1) Check for completeness and general condition of the field-strength meter. The components are listed in paragraph 6.

(2) Inspect the seatings of both fuses in the power supply (fig. 9) and check to see that spare fuses are present in the fuse holders marked SPARE. Check the connections of the storage batteries in the power supply (fig. 9) and the receiver bias batteries (fig. 7). Be sure that the vibrator (fig. 9) is seated firmly.

(3) Inspect all receiver controls and switches (fig. 8) and the VOLTAGE ADJUSTMENT control on the power supply for binding, scraping, excessive looseness, or positive switching action. Check the RECEIVER FREQUENCY and CAL OSC FREQUENCY controls for smooth tuning operation and movement of dials.

b. Weekly.

(1) Inspect the antenna dipole sections for bends, breaks, or corrosion. Be sure that the adjustable sections telescope freely. Inspect the antenna mounting head for cracks and breaks.

(2) Inspect the following items for looseness: all receiver controls and switches, the VOLTAGE ADJUSTMENT control on the power supply, the fuse holder caps, and the plug-in vibrator (figs. 8 and 9).

(3) Inspect the storage batteries for dirt, loose terminals, electrolyte level, and damaged cases. Check the positions of the battery charge indicator balls as follows (fig. 4):

(*a*) All indicator balls floating—full charge.

(*b*) Green down, white and red floating —nearly full charge.

(*c*) Green and white down, red floating —half charge.

(*d*) All indicator balls down—no charge.

c. Monthly.

Caution: Disconnect the power cord from the receiver before performing the following operations. Upon completion, reconnect the power cord and check the equipment for satisfactory operation.

(1) Remove the receiver from its carrying case by loosening the 14 captive screws around the front panel and the two screws on the rear of the carrying case. Remove the power supply from its carrying case (par. 72*c*).

(2) Inspect the fixed capacitors on the underside of the receiver chassis for leaks, bulges, and discoloration; also inspect capacitors C201 and C204 in the power supply (fig. 34). Inspect standoff capacitors C122, C124, C128, C135, C141, C143, C149, and C161 (fig. 28) for chipping.

(3) Remove the side cover plates from both the RF and the calibrating-oscillator shields (figs. 30 and 31). Inspect variable capacitors C107 and C115 in the RF section (fig. 30) and variable capacitor C167 in the calibrating-oscillator section (fig. 31) for dirt, moisture, or loose mountings. Inspect turret contacts, wipers, coils, and RF TRIMMER capacitor C108 for dirt, moisture, and loose mountings. Inspect turret detents (figs. 30 and 31) for looseness.

Caution: Do not bend or move the plates of variable capacitors C167, C107, C115, and trimmer capacitor C108 if they must be cleaned. Disturbance of plate settings and clearances will result in receiver misalignment and loss of frequency calibration.

(4) Inspect fixed resistors and small choke coils, on the underside of the receiver chassis, in the RF and calibrating-oscillator sections, and in the power supply, for cracks, chipping, blistering, discoloration, or moisture. Inspect rectifier crystals CR101 and CR102 (fig. 29) for loose glass envelopes.

(5) Inspect cams and plungers of the RF and IF attenuators Z101A and Z101B (fig. 26), and linkages of RESPONSE

switch S102 (fig. 27) for dirt, corrosion, and moisture. Clean them with Cleaning Compound until they operate freely. Inspect all set screws and tighten them if necessary.

(6) Inspect the gears of the main tuning drive and calibrating-oscillator tuning drive (figs. 30 and 31) for dirt and moisture.

(7) Inspect all potentiometer controls for signs of overheating, including the VOLTAGE ADJUSTMENT control in the power supply. Inspect all chokes in the receiver for signs of overheating; also T201, T202, L201, L202, and L203 in the power supply (figs. 33 and 34).

(8) If the receiver is to be shipped or stored, remove the bias batteries from their compartment on the front panel and remove the storage batteries from the power supply (par 72*b*).

(9) Inspect selenium rectifier CR201 (fig. 33) for signs of overheating.

(10) Inspect the storage batteries for short circuits and dead cells. Each battery should deliver at least 2 volts with no load.

Section III. TROUBLESHOOTING AT ORGANIZATIONAL MAINTENANCE LEVEL

27. General

The troubleshooting and repair work that can be performed at the organizational maintenance level is limited in scope by the tools, test equipment, and replacement parts issued. Troubleshooting, therefore, is based on the performance of the equipment in determining such troubles as burned-out tubes and defective cables. If the fault cannot be determined and corrected through organizational procedures, troubleshooting by a field radio repairman is required.

28. Visual Inspection

a. When the cause of failure is not immediately apparent, visually inspect as many of the following conditions as is practicable before continuing to more detailed procedures.

(1) Improperly connected receiver bias batteries.

(2) Improperly connected, discharged, or defective storage batteries in the power supply.

(3) Worn, broken, or disconnected power and antenna cords and connectors.

(4) Unlighted or defective receiver tubes.

(5) Defective selenium rectifier in the battery charger of the power supply.

(6) Defective vibrator.

Warning: The failure of the selenium rectifier can result in poisonous fumes and the deposit of dangerous selenium compounds. If the rectifier burns out or arcs over, the odor is strong. Provide adequate ventilation immediately. *Avoid inhaling the fumes and do not handle the damaged rectifier until it has cooled.*

b. When the vibrator is operating it will buzz; if it is silent when the POWER switch is thrown to START or ON and batteries are known to be charged (and FUSE 10A is good), the vibrator is defective. If possible, obtain information from the operator of the field-strength meter regarding its performance at the time trouble occurred.

29. Electron Tube Replacement Techniques

To prevent the discarding of good electron tubes as faulty, follow the procedures given below when troubleshooting the field-strength meter.

a. Inspect all cables, connectors, batteries, and the general condition of the receiver before removing the electron tubes.

b. Isolate the trouble, if possible, to a particular section of the receiver. (Use the equipment performance checklist (par. 31) as a guide.)

c. If a tube tester is available, remove and test one tube at a time. Substitute new tubes only for those that are defective. (This step may be performed after the procedure outlined in *d* below.)

d. If a tube tester is not available, troubleshoot the receiver by the tube substitution method.

(1) Replace one of the suspected tubes with a new tube.

(2) Check to see whether the receiver is operative.

(3) If the receiver is operative, discard the original tube.

(4) If the receiver is inoperative, remove the new tube and reinsert the original tube.

(5) Continue to check the suspected tubes, using the procedure given in (1) through (4) above, until the receiver becomes operative or (if the receiver does not become operative) until all the suspected tubes have been checked.

e. If the receiver is inoperative after the procedure outlined in *a* through *d* above is completed, continue as follows:

(1) Replace the suspected tubes, one at a time, with new tubes until the receiver becomes operative or (if the receiver does not become operative) until all the suspected tubes are replaced by new ones. Note the sockets from which the original tubes were removed. If the receiver begins to operate, discard the last tube removed.

(2) Reinsert the remaining original tubes, one at a time, in the original sockets. If the receiver fails to operate during this step, discard the original tube last reinserted. *Do not leave a new tube in a socket if the receiver operates satisfactorily with the original tube.*

f. If tube substitution does not correct the trouble, *reinsert the original tubes in the original sockets* before forwarding the defective receiver for higher echelon repair.

g. Discard tubes when:

(1) A test by a tube tester or other instrument shows that a tube is defective.

(2) The tube defect is obvious. For example, if the glass envelope is broken, if the heater does not light, or if a connecting prong is broken.

h. Do not discard tubes merely because they have been used for some length of time. *Satisfactory operation in a circuit is the final proof of the tube quality.* The tube in use may work better than a new one.

i. Do not discard tubes merely because they fall on, or slightly above, the minimum acceptable value when checked in a tube tester. Some new tubes fall near the low end of the acceptable range, but they may provide satisfactory performance throughout a long period of operational life at this *near limit* value.

j. Be careful when withdrawing a miniature tube from its socket. *Do not* rock or rotate the top of a miniature tube when removing it from its socket; pull it straight out.

30. Troubleshooting by Using Equipment Performance Checklist

a. General. The equipment performance checklist (par. 31) will help the operator to locate trouble. The list gives the item to be checked, the conditions under which the item is checked, the normal indications to be expected, and the corrective measures the operator can take. *To use this list, follow the items in numerical sequence.*

b. Action or Condition. For some items, the information given in the action or condition column consists of various switch and control settings under which the item is to be checked. For other items, it gives an action that must be taken to produce the normal indication given in the normal indications column.

c. Normal Indications. The normal indications listed include the visible and audible signs that the operator should note when he checks the items. If the indications are not normal, the operator should apply the recommended corrective measures.

d. Corrective Measures. The corrective measures listed are those that the operator or organizational repairman can make without turning in the equipment for repair at a higher echelon. If the recommended corrective measures do not produce results, trouble shooting at a field maintenance level is necessary. If a corrective measure requires checking or replacing electron tubes, carefully follow the procedures given in paragraph 29.

31. Equipment Performance Checklist

	Item No.	Item	Action or condition	Normal indications	Corrective measures
PREPARATORY	1	Power cord	Connected between POWER connector and power supply.		
	2	Antenna cable	Connected between ANTENNA connector and antenna.		
	3	Storage batteries	Batteries fully charged	All charge indicator balls afloat.	Connect charger to 110 volts ac and throw CHARGER switch to ON.
	4	Antenna dipole	Set to length as shown on megacycle rule.		
	5	Headset	Connected to AUDIO OUTPUT jack.		
START	6	POWER switch	Turn to START position	Panel lamp lights and vibrator buzzes. Signal level meter deflects.	Check fuses in power supply (par. 10). Check continuity of power cord with multimeter. Replace vibrator. Check panel lamp.
	7	CALIBRATE SWITCH	Turn to FIL position.		
	8	VOLTAGE ADJUSTMENT control.	Rotate control and read calibration meter.	Adjust for calibration meter indication on red line.	Check battery charge (par. 26*b*(3).
	9	CALIBRATE SWITCH	Turn to PLATE position	Calibration meter indicates on red line.	Same as item 8.
	10	ZERO switch	Press down and hold to check items 11 through 13.		
	11	ZERO start control	Rotate and read signal level meter.	Signal level meter adjusted to read 0 microvolts.	Check battery charge (par. 26*b*(3).
	12	POWER switch	Turn to ON position.		
	13	ZERO ON control	Rotate and read signal level meter.	Signal level meter again adjusted to read 0 microvolts.	Bias battery defective. Replace battery (par. 12*e*).
EQUIPMENT PERFORMANCE	14	OUTPUT switch	In LIN position.		
	15	RESPONSE switch	In SHARP position	Sharp peaking of signals	Check RESPONSE switch linkage.
	16	FM DISCRIMINATOR switch.	At OFF position for AM, at ON position for FM.		
	17	ATTENUATOR control	At 0 or 14	On-scale reading of signal level meter.	Reset to higher attenuation for on-scale reading.
	18	RECEIVER BAND SELECTOR switch.	Position to desired band		
	19	RECEIVER FREQUENCY control.	Rotate to tune to station frequencies in band.	Signal heard in headphones. Peaks observed on signal level meter.	Adjust GAIN control to higher setting. Rotate antenna dipole. Check antenna cable. Try BROAD position of RESPONSE switch. Remove case and check tubes (par. 29). Change antenna location to higher site.
	20	RECEIVER BAND SELECTOR switch.	Set to each band; use procedure in item 19.		

	Item No.	Item	Action or condition	Normal indications	Corrective measures
EQUIPMENT PERFORMANCE	21	FM DISCRIMINATOR switch.	Set to OFF position.		
	22	ATTENUATOR control.	Operate from 0 to 80 db positions.	Signal level meter indications decrease in labeled steps.	Check all tubes (par. 29).
	23	GAIN control	Rotate from 0 to 10	Signal increases smoothly in headset.	Clean GAIN control with Cleaning Compound.
	24	CALIBRATE SWITCH.	Turn to ON CAL OSC position.		
	25	OSCILLATOR OUTPUT control.	Rotate for red-line indication on calibration meter.	Needle rests at red line	Check battery charge (par. 26*b*(3).
	26	CAL OSC BAND SELECTOR switch.	Position to receiver band.		
	27	CAL OSC FREQUENCY control.	Rotate to receiver frequency.		
	28	PUSH TO CAL. switch	Hold in and fine-tune calibrating oscillator to receive frequency with CAL OSC FREQUENCY and RF TRIMMER controls.	Signal level meter peaks	Check all tubes (par 29). Check security of cable connections to PUSH TO CAL. switch S107 (fig. 26). Check to see that the RECEIVER BAND SELECTOR and the CAL OSC BAND SELECTOR are on the same bands.
	29	CAL OSC BAND SELECTOR and RECEIVER BAND SELECTOR switches.	Set to each band; use procedures in items 26 through 28.	Read dial on band selected.	Same as item 28.
STOP	30	GAIN and OSCILLATOR OUTPUT control.	Rotate to 0.		
	31	POWER switch	Turn to OFF position.		

CHAPTER 5

THEORY

Section I. RECEIVER AND ANTENNA

32. General

Field Strength Meter AN/URM–91 is used to measure the field intensity of radiated cw, AM, or FM signals. For measurement of radio interference (noise), approved radio interference measuring equipment should be used.

a. Field-strength measurements are usually expressed in microvolts per meter. The figure is obtained by dividing the potential difference between the receiving antenna system and ground by the distance, in meters, between those two points. A more practicable method to determine field strength consists in measuring the voltage induced across an antenna by a passing wave and applying the following formula:

$$FS=\frac{E_a}{h_e}$$

Where: FS=field strength in microvolts per meter,
E_a =voltage induced across the antenna in microvolts,
h_e =effective height of antenna in meters.

(1) The receiver of the field-strength meter indicates the voltage that is present at the ANTENNA input connector of the receiver.

(2) The effective height of the dipole antenna supplied with the field-strength meter is provided by the antenna constant K; it is shown plotted versus frequency in figure 10. The constant also takes into account the efficiency of the transfer of energy from the antenna to the receiver.

b. Because of wide differences in field intensities, it is more convenient to measure field strength in decibels (db) above 1 microvolt per meter, rather than directly in microvolts per meter. For this reason, the receiver ATTENUATOR control and the signal level meter are calibrated in db above 1 microvolt.

33. Measurement of Field Strength

The field-strength meter determines the field strength of a wave in the following manner:

a. Both the receiver and the calibrating oscillator are first tuned to the transmitter frequency. The output of the calibrating oscillator is adjusted to a standard of 10,000 microvolts; this standard signal is fed to the receiver. The signal level meter is graduated in db above 1 microvolt, with a full-scale reading of 14 db (in linear output operation). The attenuator is set to a signal reduction of 66 db, and the receiver gain is adjusted to a 14-db meter indication for the calibrating-oscillator signal. The sum of the attenuator reduction of 66 db and the meter indication of 14 db is 80 db, which is the equivalent of 10,000 microvolts, using 1 microvolt as a base. Since the combination of the signal level and the ATTENUATOR control indicates the true field strength of the calibrating-oscillator standard signal, the receiver gain is calibrated accurately for transmitter field-strength measurements at the chosen frequency.

b. The calibrating signal is removed and the strength of the received signal is read on the signal level meter. The ATTENUATOR control is adjusted to produce an on-scale indication on the meter. The sum of the ATTENUATOR setting and the meter indication give the voltage of the received signal at the input to the receiver.

c. Decibels are logarithmic ratios; their ad-

dition or subtraction represents multiplication or division of linear quantities. Since the signal level meter reading, the attenuator setting, and the antenna constant are all in db, the theoretical formula for field strength stated in paragraph 32*a* is transformed from a ratio to a simple addition. The resultant formula for determining the field strength of a received signal is:

$$FS=S+A+K$$

Where: FS=field strength in db above 1 microvolt per meter,
S =signal intensity in db as read on the signal level meter,
A =signal reduction in db in the receiver due to attenuator setting,
K =antenna coefficient in db as determined from graph mounted inside cover of receiver (fig. 10).

34. Block Diagram

a. General. The signal path through the field-strength meter is shown in the block diagram (fig. 13). The radio-frequency (RF) signal from the antenna is first applied to the RF attenuator. The alternate RF input to the attenuator is from the calibrating oscillator. The attenuated signal is amplified, and then heterodyned with the output of the local oscillator. The resultant intermediate frequency (IF) signal is further attenuated at a known decibel rate in the IF attenuator. Four stages of IF amplification follow. The amplification of the second and third IF stages is either linear or logarithmic, depending on the setting of the OUTPUT switch. Selection of broad or sharp bandwidth in all IF stages is also provided. The audio component of the signal is removed by the AM detector or by the FM discriminator. One multipurpose tube provides AM detection, one stage of audio amplification, and automatic gain control (agc). Output is read on a meter calibrated in microvolts and in decibels. Audio and recorder outputs are also provided.

35. Calibrating Oscillator

(fig. 14)

a. General. The calibrating oscillator generates a signal that is fed to the receiver to calibrate the gain of the receiver in preparation for a field-strength reading. The calibrating-oscillator signal is tuned over the same frequency bands as the receiver, and its signal output level can be adjusted to provide a standard signal input of 10,000 microvolts to the receiver.

b. Oscillator Operation. The calibrating-oscillator stage, V109, using a type 6C4 triode, is connected in a modified Colpitts oscillator circuit. The grid of V109 is tuned by T110, which consists of a coil and a capacitor in each of the three frequency bands. The coils are slug-tuned. Continuous tuning within each band is provided by a dual rotor capacitor, C167A and C167B, the CAL OSC FREQUENCY control. Capacitor C168 and resistor R153 develop grid-leak bias. The plate of V109 is connected directly to the tuned grid circuit to provide the feedback necessary to maintain oscillation. RF choke L110 and capacitor C171 filter the plate current to keep RF pulses from the B supply. RF choke L111, with capacitors C170 and C169, filters RF currents in the heater circuit. The OSCILLATOR OUTPUT control, R154, permits variation of plate voltage to V109 for adjustment of oscillator signal output to the standard level of 10,000 microvolts (*d*(4) below). Output of the calibrating oscillator is taken from the secondary winding of T110, and coupled by transformer link T112 to calibrating-oscillator attenuator Z103. The signal is attenuated at a ratio of 50 to 1 in Z103. When PUSH TO CAL. switch S107 is pressed, the receiver antenna is disconnected, and the calibrating-oscillator signal from Z103 is fed through the RF attenuator to the receiver input.

c. Thermocouple Circuit. The RF output of the calibrating oscillator is also coupled by link transformer T112 to thermocouple TC101; this RF output heats the thermocouple. At the junction of the two dissimilar metals in TC101, a voltage proportional to the signal output of the calibrating oscillator is developed. With CALIBRATE SWITCH S106 (fig. 15) in the ON CAL OSC position, the thermocouple output is fed to calibration meter M102 through RF chokes L112 and L113. These chokes and feed-through capacitor C176 filter RF from the meter circuit.

d. CALIBRATE SWITCH and Calibration Meter Circuits (fig. 15). CALIBRATE SWITCH S106 has four positions.

(1) In the PLATE position, section 1 rear

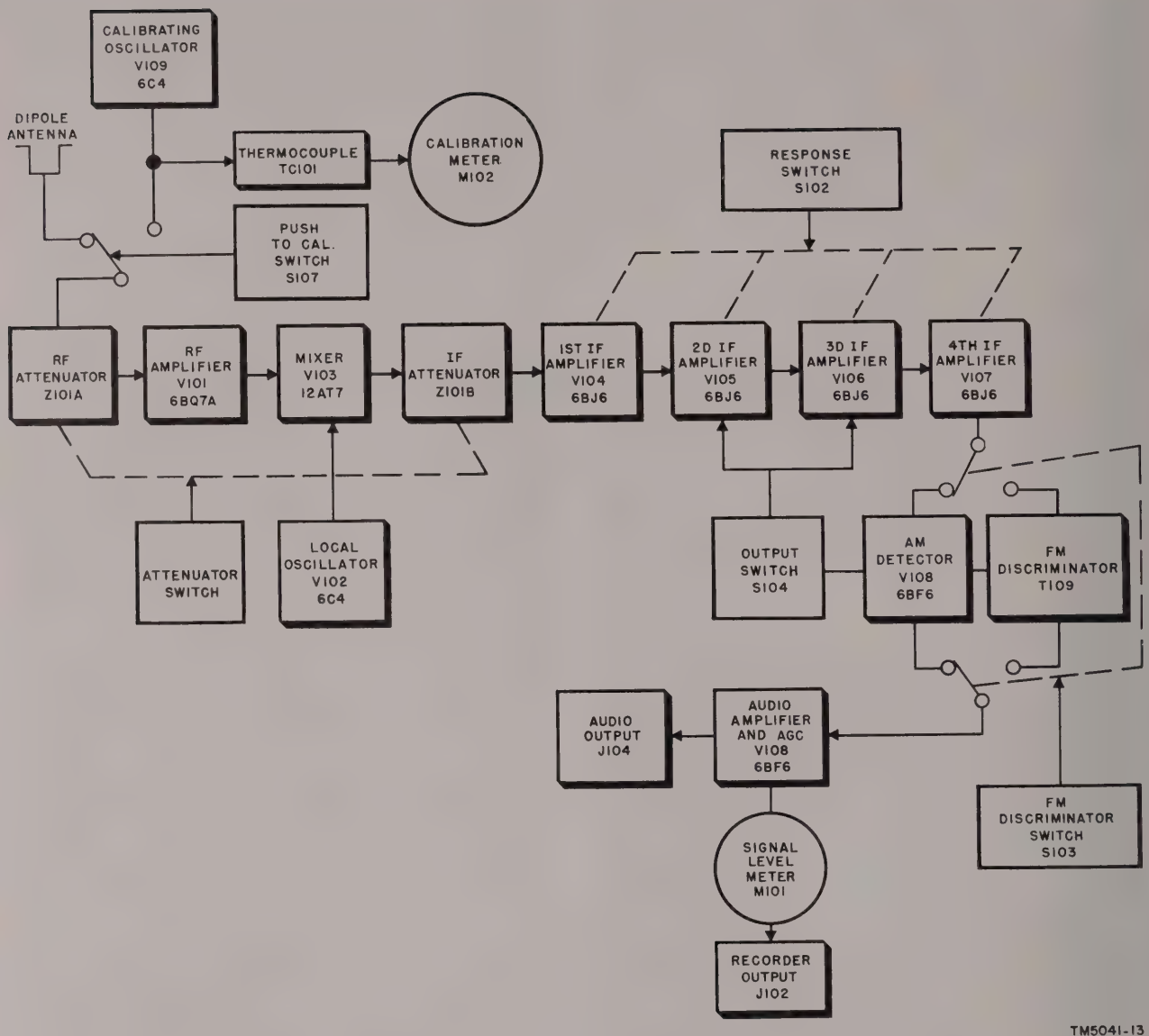


Figure 13. Receiver, block diagram.

is connected to the junction of voltage divider resistors R150 and R151. The voltage at the junction is applied to calibration meter M102 for checking the regulation of the +150-volt line.

(2) In the FIL position, 6-volt power from the storage batteries is connected through section 1 rear of the switch to meter M102 from the junction of voltage divider resistors R148 and R149. This checks the filament voltage. The level of filament voltage is adjusted by rotating VOLTAGE ADJUSTMENT control R201 in the power supply.

(3) In the OFF position, the calibration meter is grounded.

(4) In the ON CAL OSC position, +150 volts is applied through section 2 rear, segment Y, of the switch to the plate circuit of calibrating oscillator V109. Filament voltage is applied through section 2 rear, segment Z, of the switch to the heater of tube V109. Current from thermocouple TC101, which is proportional to the calibrating oscillator's signal output, is fed through section 1 rear of the switch to calibration meter M102. Variable resistor R155 is preset by a screw

driver adjustment to a value that causes a red-line meter indication when the calibrating-oscillator signal output is 10,000 microvolts. The output level of the calibrating oscillator is adjusted by rotating OSCILLATOR OUTPUT control R154 (fig. 14).

36. RF and IF Attenuators

(fig. 38)

The ATTENUATOR control permits signal attenuation in accurate steps from 0 to 80 db. RF attenuator Z101A consists of two parallel pairs of pi-type resistive networks. Intermediate-frequency attenuator Z101B consists of four pi-type resistive networks. At the 0-db setting, none of the networks is in the signal path; therefore, the RF input signal is applied directly to RF amplifier V101, and the IF signal from the mixer is fed directly to the primary of IF transformer T103. At the 14-db setting, one network in IF attenuator Z101B is inserted in the IF signal path. Each successive setting through 54 db inserts an additional network in Z101B. The 66-db setting adds a parallel pair of networks from RF attenuator Z101A in the RF signal path. The 80-db setting adds a second parallel pair in the RF signal path. The resistors that form the pi-type networks are of close tolerance. They are sealed in fully inclosed shields to prevent radiation.

37. RF Amplifier

(fig. 16)

a. The input signal to RF amplifier V101 is taken from the antenna or the calibrating oscillator through RF attenuator Z101A. The tube operates as a grounded grid push-pull amplifier, and the amplified output signal is fed to mixer stage V103. Signals in three frequency bands are available: 18 to 35 mc, 33 to 66 mc, and 62 to 125 mc, depending on the setting of the RECEIVER BAND SELECTOR switch.

b. The input signal is fed through ANTENNA jack J101, or from calibrating oscillator V109, through PUSH TO CAL. switch S107 to RF attenuator Z101A. The signal is injected into the cathode circuit across resistors R101 and R102 through blocking capacitors C101 and C102. Signals developed in the tuned

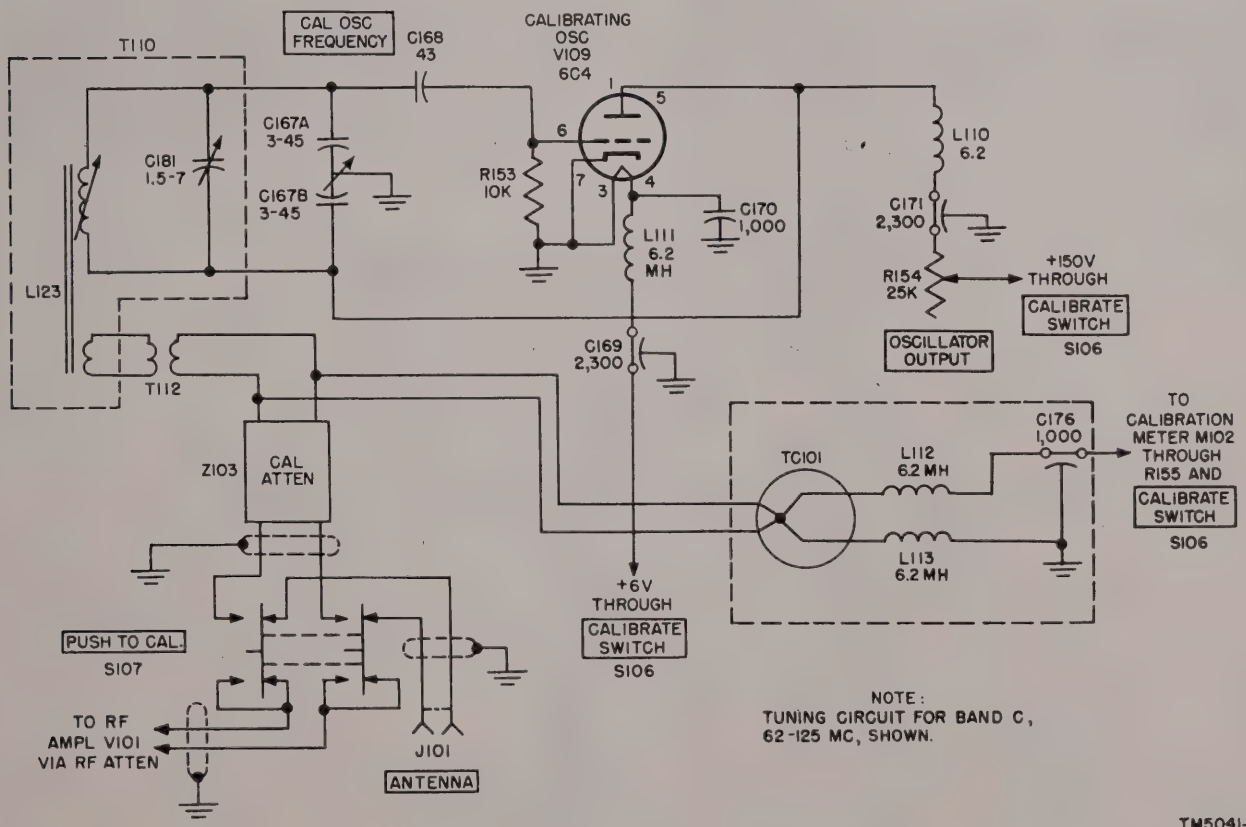


Figure 14. Calibrating oscillator, schematic diagram.

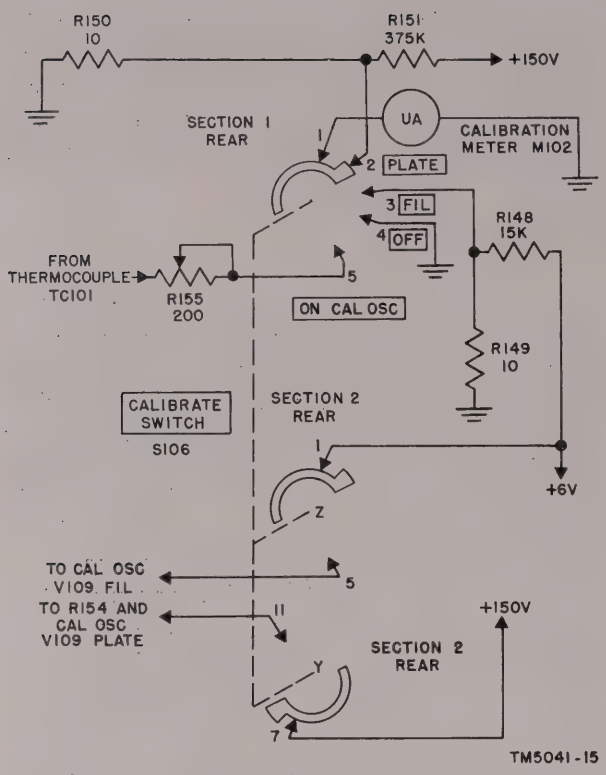


Figure 15. CALIBRATE SWITCH circuits.

circuit consisting of T101, C107 (RECEIVER FREQUENCY), and C108 (RF TRIMMER), are coupled through capacitors C109 and C110 to the grids of tube V103A and V103B as input signals.

c. Plate voltage for V101 is taken from the 150-volt supply through the closed contacts of S101A. The voltage is dropped by resistor R103. RF is bypassed by feed-through capacitor C105.

38. Local Oscillator

a. General. The local oscillator generates a signal that is always 10.7 mc above the frequency of the received signal in each of the three frequency bands. The output of the local oscillator is fed to the mixer stage for heterodyning with the received signal.

b. Oscillator Operation. Local oscillator tube V102, a type 6C4 triode, is connected in a modified Colpitts oscillator circuit. The grid of V102 is tuned by T111, which consists of a coil and a capacitor in each of the three frequency bands. The coil in each band is slug-tuned; the capacitor in each band is tuned during alinement of the receiver by a screw driver adjustment. Continuous tuning within each band is provided by a dual-rotor variable capacitor, C115A and C115B, which is operated by the RECEIVER FREQUENCY control. Capacitor C114 and resistor R104 develop grid-leak bias. The plate of V102 is connected to the tuned grid circuit to provide the feedback necessary to maintain oscillation. RF choke L103 and feed-through capacitor C113 filter the RF pulses

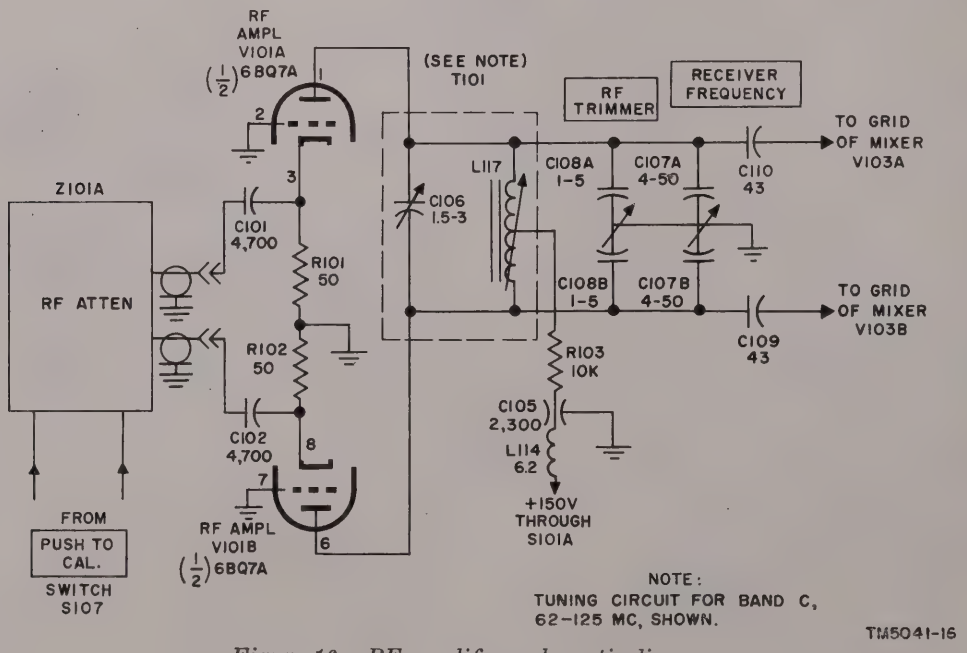


Figure 16. RF amplifier, schematic diagram.

in the plate circuit of tube V102, keeping them from the B supply. The signal output of the local oscillator is coupled to the mixer stage through coupling capacitors C116 and C117.

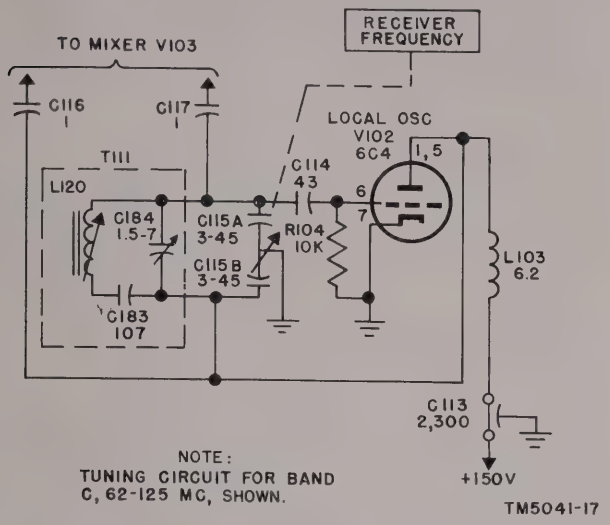


Figure 17. Local oscillator, schematic diagram.

39. Mixer

(fig. 18)

a. The input signals to the mixer are taken from the local oscillator and the RF amplifier. The two signals are heterodyned, or mixed, in the circuit of V103. The resultant intermediate frequency of 10.7 mc represents the difference between the two input frequencies, and it appears in the tuned primary of transformer T102. The IF signal is coupled to the secondary of T102, fed through IF attenuator Z101B to the primary of T103, and coupled through the secondary to the first IF amplifier V104.

b. Tube V103 operates with the grids of the dual-triode in push-pull and the plates in push-push. Input signals (*a* above) are developed across resistors R105 and R106 and fed to the grids. By mixing the two input signals, beat signals are developed. Because the primary of transformer T102 and capacitor C120 form a resonant circuit at 10.7 mc, only signals at that frequency are fed to the secondary of T102 and then to V104 through Z101B.

c. Plate voltage for the tube is taken from the +150-volt line through the closed contacts of S101A. Capacitors C105, C119, and C190, with resistor R108, decouple the plate circuit from the power supply. Cathode bias is developed across resistor R107 and capacitor C118.

40. First IF Amplifier

(fig. 19)

a. General. First IF amplifier V104, a type 6BJ6 pentode, amplifies the IF signal of 10.7 mc. The signal from IF attenuator Z101B is inductively coupled to the grid of V104 through input transformer T103, amplified, and then coupled to the next stage through output transformer T104.

b. Amplifier Operation. The secondary of T103 is tuned to 10.7 mc by capacitor C121; the secondary winding is slug-tuned for accurate alinement of the receiver. Resistor R110 widens the bandwidth of the IF signal. Resistors R111 and R112 and capacitors C123 and C125 de-

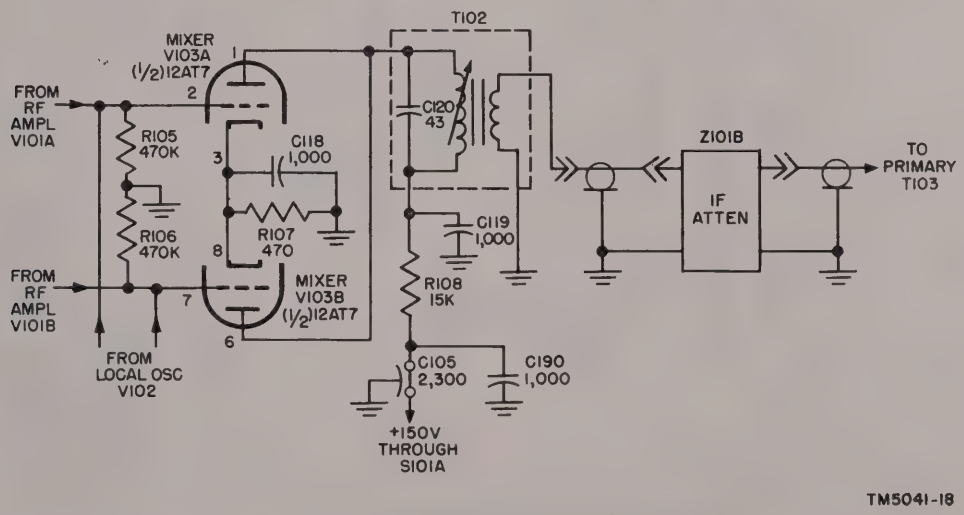


Figure 18. Mixer, schematic diagram.

couple the plate circuit from the power supply. Resistor R113 is the screen-dropping resistor and C124 is the screen-bypass capacitor. A bias of —1.5 volts is applied to the control grid of V104 from bias battery BT101 through a grid decoupling network consisting of resistor R109 and capacitors C122 and C178. Both the cathode and the suppressor grid of tube V104 are connected to ground. The slug-tuned primary of IF transformer T104, with C126, is tuned to 10.7 mc.

c. SHARP and BROAD Responses. In the SHARP position of RESPONSE switch S102A, the secondary of IF transformer T104 is tuned by capacitor C127. Primary-to-secondary coupling is such that the bandwidth is narrowed to 48 kilocycles (kc) at the 6-db points and sharply peaked. In the BROAD position of switch S102A, a tertiary winding and a 10-ohm resistor, R114, are introduced in series with the secondary of T104, increasing the coupling and thereby broadening the bandwidth of the IF signal to 155 kc at the 6-db points. Receiver gain is reduced approximately 12 db in the BROAD position. BROAD is used when searching for and identifying a signal; SHARP is used when making a field-strength reading. RESPONSE switch operation in the BROAD and SHARP positions is identical for each of the three succeeding IF transformers, T105, T106, and T107.

41. Second and Third IF Amplifiers
(fig. 20)

a. General. The second and third IF amplifiers are identical in circuit and operation; therefore, the description of the second IF amplifier in *b* and *c* below may be applied to the third amplifier by substitution of the comparable reference symbol for each part.

b. Amplifier Operation. The IF signal from the tuned secondary of T104 is applied to the control grid of tube V105, a type 6BJ6 pentode. The amplified signal at the plate is fed to the primary of T105, which, with capacitor C133, is tuned to 10.7 mc. The slug-tuned primary

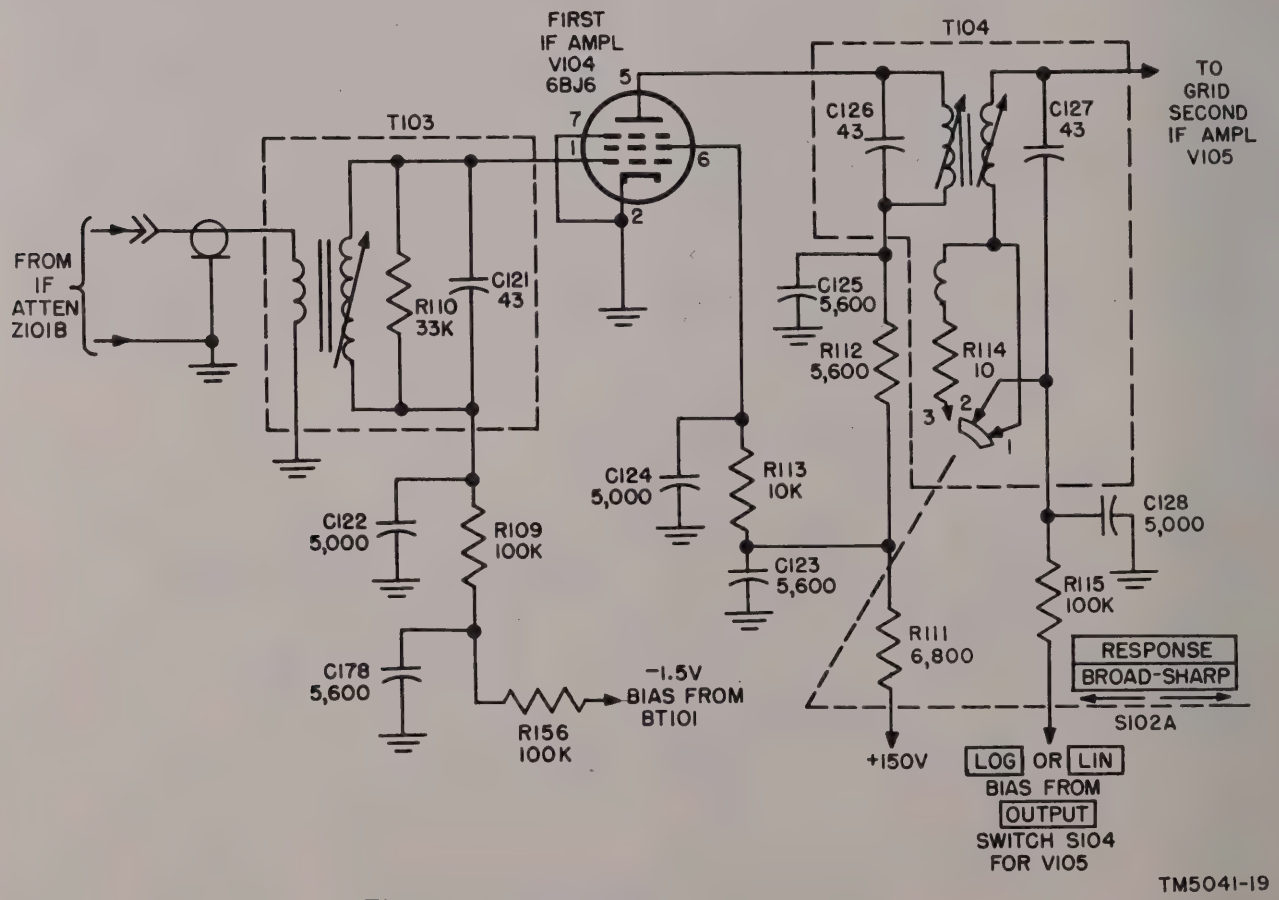


Figure 19. First IF amplifier, schematic diagram.

and secondary of T105 are adjusted during alinement of the receiver. Capacitor C129 and resistor R116 tend to lessen changes in tube characteristics with changes in signal level (Miller effect). Resistors R117 and R119, with capacitors C130 and C132, decouple the plate circuit from the power supply. Resistor R118 is the screen-dropping resistor and capacitor C131 is the screen-bypass capacitor.

c. Logarithmic and Linear Output. Receiver output can be made either linear or logarithmic by the setting of OUTPUT switch S104. The circuits associated with S104 are shown in figure 22.

(1) With S104 in LIN position, a bias of 1.5 volts from bias battery BT101 is applied to the grids of V105 and V106. This battery bias, in addition to the slight cathode bias developed across resistors R116 (for V105) and R122 (for V106), operates the tubes on the linear portion of the tube transfer characteristic. The wave form of the output of tubes V105 and V106, though amplified, remains substantially the same as the signal input. With switch S104 in LIN position, field-strength indications are read on the lower (black) DECIBELS scale of signal level meter M101.

(2) With S104 in the LOG position, the bias applied to the control grids of V105 and V106 is derived from the circuit associated with bias battery BT102 and the agc circuit of V108. These circuits are shown in figure 22 and described in paragraphs 43 and 44. Cathode bias is developed across resistors R116 (for V105) and R122 (for V106). With switch S104 in the LOG position, the bias on tubes V105 and V106 is increased to approximately 4.5 volts. This moves the operating point of the tubes from the linear portion down to the curved or logarithmic portion of the transfer characteristic. The output of V105 and V106 becomes smaller in magnitude and asymmetrical about the logarithmic operating point. Agc bias from the am detector of tube V108 is also applied to the grids of V105 and V106 in logarithmic output. When signal strength increases, the agc bias becomes more negative and reduces the gain of the tubes, thereby limiting the amplitude of the swing of the output about the logarithmic operating point. Therefore, the output wave form of V105 and V106 (and the receiver output) are proportional to the logarithm of the input, and sharp increases in signal strength are reduced in magnitude. Logarithmic output is used when an auxiliary recording device is connected for field-strength measurements over an extended time. Field-strength indications in logarithmic output are read on the upper (red) DB scale of signal level meter M101.

(3) Linear or logarithmic bias is applied to the control grid of tube V105 through the secondary of IF transformer T104. Resistor R115 and capacitor C128 decouple the bias supply from the RF signal on the grid. The secondary of T105, resistor R121, and capacitor C135 serve the same functions for tube V106.

42. Fourth IF Amplifier

(fig. 21)

a. General. Fourth IF amplifier V107, a type 6BJ6 pentode, receives its signal input from the tuned secondary of IF transformer T106. After amplification in tube V107, the IF signal is inductively coupled to the am detector circuits of V108 through IF transformer T107, or is fed directly to the FM discriminator.

b. Amplifier Operation. The input signal from the tuned secondary of IF transformer T106 is applied directly to the gird of tube V107. Capacitor C144 and resistor R130 tend to lessen changes in tube characteristics with changes in signal level (Miller effect). A bias of 1.5 volts is applied to the grid of tube V107 from bias battery BT101 through the decoupling network consisting of resistor R126 and capacitor C141.

(1) With FM DISCRIMINATOR switch S103 in the OFF position, the amplified signal from tube V107 is fed to the primary of IF transformer T107 for coupling to the AM detector. Resistors R131 and R133, with capaci-

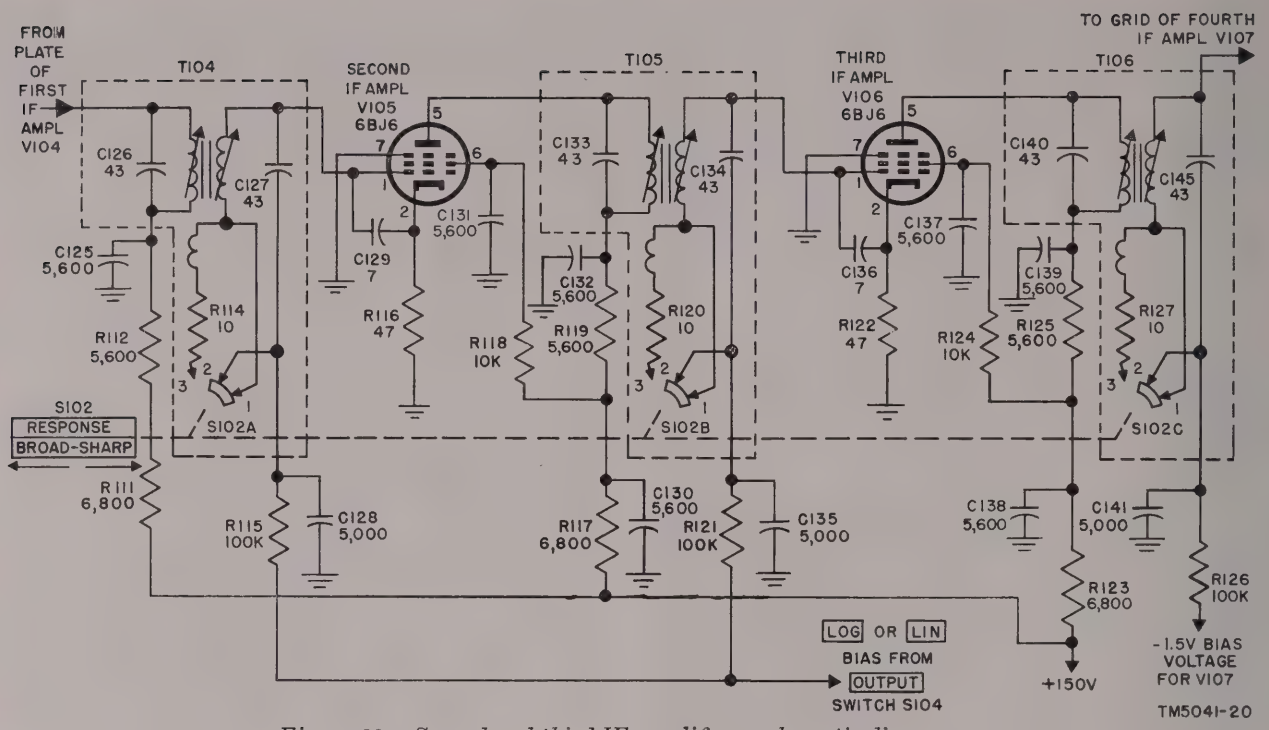


Figure 20. Second and third IF amplifiers, schematic diagram.

tors C148, C149 and C189, decouple the plate circuit from the power supply. Resistor R132 is the screen-dropping resistor and capacitor C146 is the screen-bypass capacitor.

(2) With switch S103 in the ON position, the output of tube V107 is fed to the FM discriminator (fig. 23). The FM discriminator then forms the plate load for tube V107. Plate voltage for tube V107 is applied through the primary of T109. Resistor R145 and capacitors C162 and C179 replace the decoupling network made up of resistor R133 and capacitors C148, C149, and C189. With switch S103 in the OFF position, plate voltage for tube V107 is dropped across resistors R131 and R133, which have a total resistance of 12,400 ohms. With switch S103 in the ON position, plate voltage for tube V107 is dropped across R145 (5,600 ohms) operating tube V107 at a higher plate voltage.

c. GAIN Control. A maximum bias of +5 volts is applied to the cathode of tube V107 through the voltage divider made up of GAIN control R129 and fixed resistor R128. This divider is connected across the 150-volt B+ supply. In addition, cathode bias is developed across resistor R130 and the GAIN control. Increasing the GAIN control setting clockwise from 0 to a higher setting shorts out more of R129; the resulting smaller voltage across the remaining unshorted portion of R129 reduces the cathode bias for tube V107. When the GAIN control is set at 0, the movable contact is schematically at the top of R129, and tube V107 operates near cutoff. Capacitors C142A and C143 bypass R129 to maintain steady bias.

d. ZERO Switch. ZERO switch S101 is normally closed. It is opened to zero the receiver output and signal level meter M101 (par. 44*b*). When pressed, one section of ZERO switch S101A removes plate voltage from RF amplifier V101 and mixer V103 (figs. 16 and 18) to eliminate all signal input to the IF amplifier section of the receiver. The other section, S101B, opens the connection to the arm of GAIN control R129. Maximum cathode bias is developed across the entire resistance of R129, and tube V107 operates near cutoff; therefore, with the ZERO switch pressed, V108 (the AM detector and audio amplifier) receives no input signal.

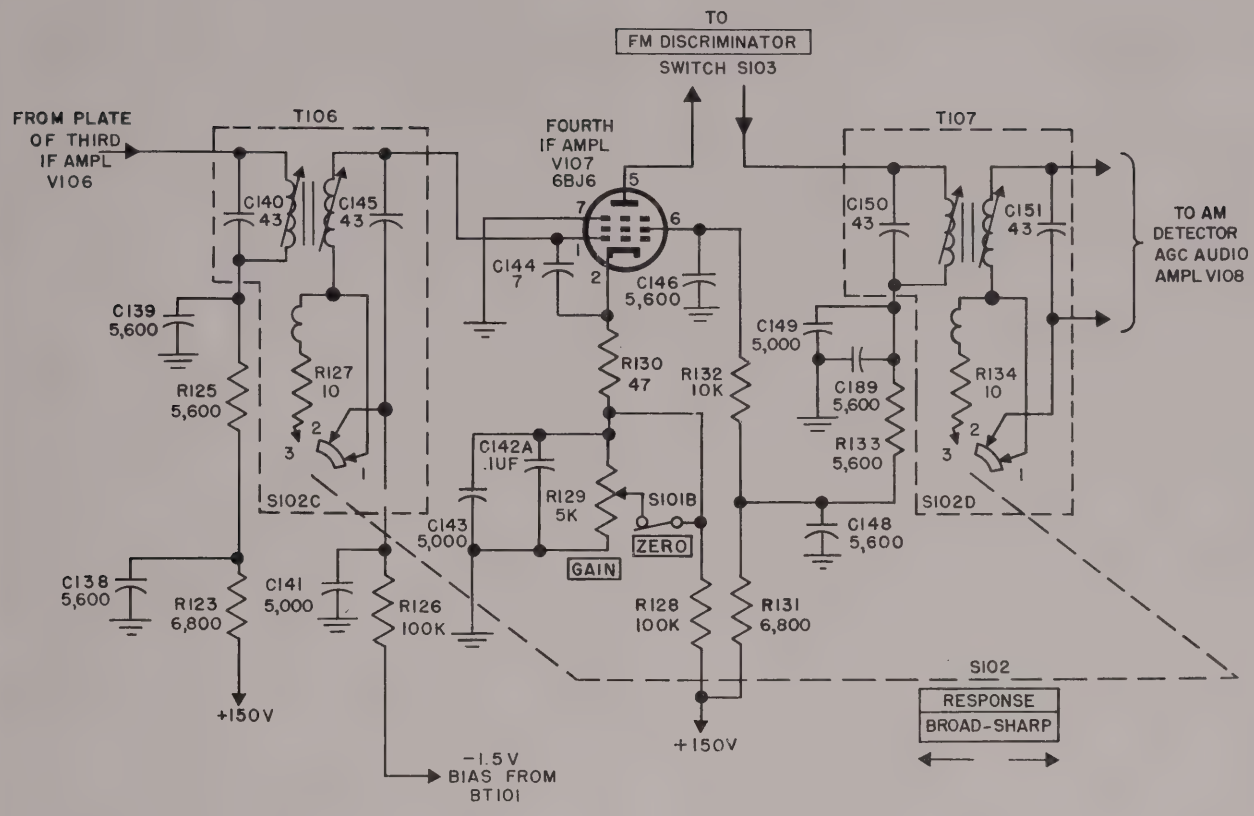


Figure 21. Fourth IF amplifier, schematic diagram.

43. Detector and Audio Amplifier Circuits (fig. 22)

Tube V108, a type 6BF6 duo-diode triode, is used for the AM detector, agc, and audio amplifier circuits.

a. AM Detector. The IF signal appearing across the secondary of T107 is applied to the diode detector circuit that is made up of the diode plates and the cathode of V108 and diode-load resistor R138. The signal that is developed across R138 is coupled directly to the control grid of the triode section of V108 through isolating resistor R139. The RF component of the detected signal is bypassed by capacitors C152 and C155.

(1) The signal applied to the control grid of V108 is a dc voltage. It varies at an audio rate when an AM carrier is being received. When an unmodulated carrier is being received, or when the output from the calibrating oscillator is being used, the dc voltage is substantially steady.

(2) The meter circuit operates the same on modulated and unmodulated signals; however, no audio output is produced by unmodulated signals.

b. Audio Amplifier. The audio signal from either the AM detector or the FM discriminator is applied to the control grid of tube V108 for amplification. In the ON position of switch S103, a bias of 1.5 volts is applied to the grid of V108 (fig. 23). In the OFF position of switch S103, no battery bias is applied to the grid of V108. The amplified audio signal at the plate of V108 appears in the primary of audio output transformer T108. Capacitor C157 bypasses any remaining RF in the plate circuit. Capacitor C142B and resistor R141 decouple the plate circuit from the high-voltage supply. The secondary of audio output transformer T108 provides for connecting a 600-ohm headset at AUDIO OUTPUT jack J104. Choke L104 and feed-through capacitor C159 filter any remaining RF from the audio output. The cathode circuit of tube V108 is described in paragraph 44*b*.

44. Bias, Agc, and Signal Level Meter Circuits

(fig. 22)

a. Logarithmic and Linear Bias Circuits. With OUTPUT switch S104 in the LIN position, 1.5-volt bias from bias battery BT101 is applied to the control-grid circuits of all IF amplifiers. When OUTPUT switch S104 is in the LOG position, and POWER switch S105 is in the START or ON position, the control grids of the second and third IF amplifiers (V105 and V106) are biased for logarithmic operation. For this type of operation, bias battery BT102 is connected across log-centering potentiometer R135 through section 1, rear, of S105. The setting of R135, adjusted during alinement of the receiver, determines the amount of bias from BT102 that is applied to the grids of tubes V105 and V106. Log-centering control R135 determines the operating point on the transfer (grid voltage versus plate current) characteristic at which tubes V105 and V106 operate. Automatic gain control voltage, developed from the current flowing through log-range control R138 during positive half-cycles of AM detection, is taken from the movable contact arm of R138 to the logarithmic bias line at one end of R135. The setting of R138, adjusted during alinement of the receiver, determines the magnitude of the agc voltage applied to the grids of V105 and V106, and, therefore, the amplitude of the signal output swing about the logarithmic output operating point. Resistors R136 and R137 and capacitors C153 and C154 form a resistance-capacitance network that filters the agc bias applied in logarithmic operation.

b. Meter and Zeroing Circuits. The plate current through V108 varies inversely with the amplitude of the IF signal. A stronger signal on the diode detector plates produces a larger voltage drop through resistor R138; this drives the grid more negative, reducing the plate current through V108. Signal level meter M101 is, therefore, negative reading. A zero signal in the cathode-plate circuit of V108 causes a full deflection of the meter to 0 db. A stronger signal, that reduces the plate current through V108, causes a smaller deflection of the meter but a higher indication on the scale. In the START position of POWER switch S105, filament and plate voltage are connected to the receiver. Resistor R143 is placed in shunt with signal level meter M101 and resistor R144 through section 1, rear, of S105. With ZERO switch S101B open, all signal is removed from the grid of tube V108 (par. 42*d*). The plate voltage is then adjusted with ZERO START control R140 to produce a full-scale deflection, or 0-microvolt reading, on signal level meter M101. With the ZERO switch still open, the POWER switch is turned to the ON position. This disconnects shunt resistor R143 from the cathode circuit of tube V108 and substitutes 4.5 bias battery BT101 and ZERO ON control R142. The voltage of the battery is opposite in polarity to the voltage drop across the meter and resistor R144; therefore, it offsets the decrease in current through the meter that results from the removal of shunt resistor R143. The ZERO ON control adjusts the magnitude of the counter-voltage, permitting meter M101 to be zeroed again in the ON position. Resistor R144 completes the signal level meter circuit to ground in the absence of a recording instrument. When a recorder is used to trace a permanent record of field-strength variations, it is plugged into RECORDER OUTPUT jack J102. Resistor R144 is then disconnected and the recorder completes the meter circuit to ground. Capacitor C142C is the cathode bypass for tube V108. RF choke L105 and capacitor C156 filter RF from the cathode circuit.

45. Fm Discriminator

(fig. 23)

a. General. For reception of frequency-modulated signals, FM DISCRIMINATOR switch S103 is turned to the ON position. The IF signal of 10.7 mc is then fed to the FM discriminator. The output of the FM discriminator is the audio component of the IF signal; it is applied through switch S103 to the control grid of audio amplifier tube V108.

b. Circuit Operation. With switch S103 in the ON position, the FM discriminator, which is tuned to 10.7 mc, forms the plate load for tube V107. Plate voltage for V107 is then applied through the primary of T109. Resistor R145 and capacitors C162 and C179 decouple the plate circuit from the power supply. Both the primary and secondary of T109 are tuned to 10.7 mc by capacitors C161 and C163, respectively. The two type 1N34A crystal diodes, CR101 and CR102, rectify the audio component of the IF signal; resistors R146 and R147 are

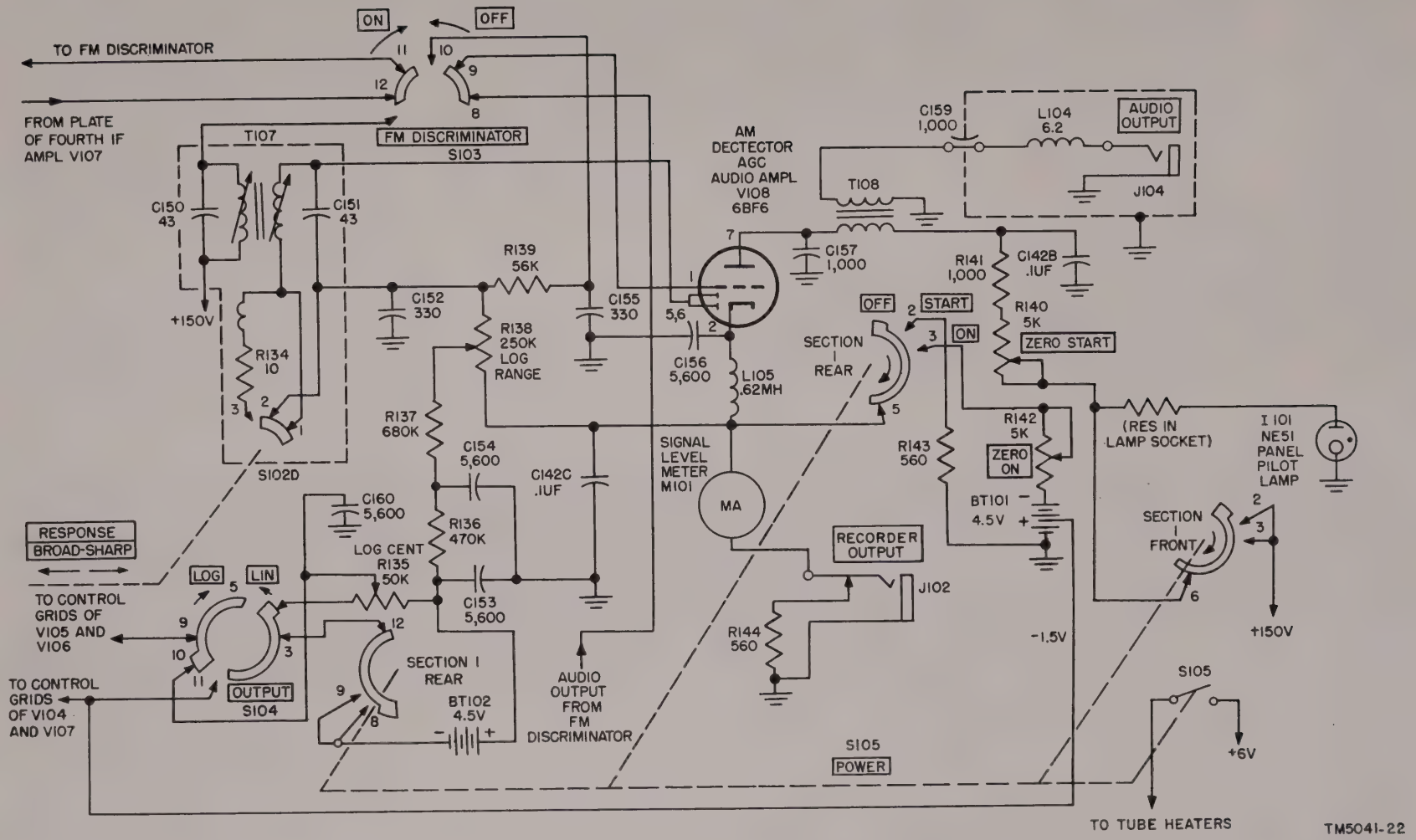


Figure 22. AM detector, agc, and audio amplifier, schematic diagram.

the load resistors for the discriminator. Capacitor C165 blocks direct-current (dc) voltage, but provides a low-impedance path for the IF signal of 10.7 mc. Therefore, one side of the primary tuned circuit, the midpoint of the secondary tuned circuit, and the junction of the two load resistors, R146 and R147, are all effectively at the same potential for intermediate frequencies.

c. Discriminator Action. The frequency-modulated IF signal from the plate circuit of tube V107 varies above and below 10.7 mc, in accordance with its audio component. The voltage of the signal from the primary tuned circuit of transformer T109 is applied to the center tap of the secondary winding and also to the junction of load resistors R146 and R147. The voltage of the input signal is the reference voltage. The voltages at the ends of the secondary of T109 are always exactly opposite in phase.

(1) At exactly 10.7 mc, when the tuned secondary of T109 is at resonance, the voltages at the ends of the secondary are also exactly 90° out of phase with the reference voltage at the center tap. The resultant voltages applied to the crystal diodes are equal and of the same polarity. Therefore, they conduct equally, developing equal voltage drops across load resistors R146 and R147. Because the voltage return is at the junction of R146 and R147, the equal voltages are in opposition and they cancel each other. No signal voltage output is obtained.

(2) When the frequency varies above 10.7 mc, the tuned secondary of T109 is slightly out of resonance; therefore, its load becomes inductive. The voltage at one end of the secondary is slightly less than 90° and the voltage at the other end is slightly more than 90° out of phase with the reference voltage at the center tap. The resultant voltages applied to the crystal diodes are unequal; therefore, the diodes conduct unequally, developing different voltage drops across load resistors R146 and R147. The opposing but unequal voltages produce a signal voltage output across R146 and R147.

(3) When the frequency varies below 10.7 mc, the tuned secondary of T109 becomes capacitive. The discriminator action and signal output are the same as in (2) above, except reversed in polarity.

d. Discriminator Output. When the IF varies above and below 10.7 mc, the signal voltage output developed across R146 and R147 is applied directly to the grid of audio amplifier tube V108 with FM DISCRIMINATOR switch S103 in the ON position. A fixed bias of 1.5 volts from bias battery BT101 is also applied to the grid of tube V108 through R146 and R147.

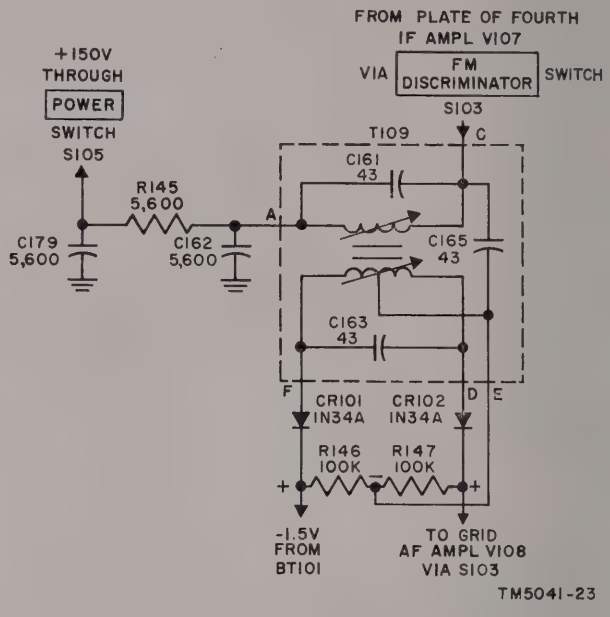


Figure 23. FM discriminator, schematic diagram.

46. Antenna

The antenna is a half-wave dipole. It consists of two quarter-wave elements that are adjustable by means of telescoping sections to the critical length for the frequency received. The dipole can be oriented either vertically or horizontally. The antenna head supports the dipole elements and also contains two 11-ohm resistors connected in series between the antenna elements and the transmission line conductors. The resistors match the 72-ohm characteristic impedance of the antenna to the 95-ohm impedance of the two-conductor transmission line and the balanced receiver input. When a signal generator with an unbalanced 50-ohm output is used for alining and testing the re-

ceiver, an impedance-matching network must be coupled to the transmission line. The impedance-matching network adds 50 ohms in series with the output impedance of the signal generator and thus closely matches the 95-ohm impedance of the balanced receiver input.

Section II. POWER SUPPLY

47. Power Supply Circuits
(fig. 24)

a. Filament Supply. Power for the filament is supplied by four storage batteries connected in series for an output of 8 volts and fed to the receiver through pin A of connector J201 and the receiver power cord. Pin D is the ground connection between the power supply and the receiver. VOLTAGE ADJUSTMENT control R201 permits adjustment of filament voltage to the red-line setting on the calibration meter of the receiver. Fuse F201, rated at 10 amperes, prevents damage to other circuit components in the event of a short circuit.

b. High-Voltage Supply. When POWER switch S105 is in the START or ON position, the 6 volts from the storage batteries is applied from pin C of power-supply connector J201 through the filter consisting of choke coil L201 and capacitors C201 and C202, to the center tap of vibrator transformer T201. Vibrator G201 is a synchronous, or self-rectifying type. Battery current that flows through the vibrator coil causes the vibrating reed to contact vibrator terminals 2 and 4 alternately, producing ac in the primary of T201. This ac voltage is stepped up by the secondary of T201. Terminals 4 and 6 of the secondary are connected to vibrator contacts 1 and 5, which are contacted by the vibrating reed simultaneously with terminals 2 and 4. At all times, pulsating dc current flows in the secondary of T201 from the center tap to either terminal 4 or 6. This unidirectional current is smoothed by the filter consisting of choke L202 and electrolytic capacitors C204A and C204B. The voltage output to the receiver at pin B of connector J201 is approximately 158 volts. RF choke L203 and feedthrough capacitor C205 filter RF from the output circuit. Capacitor C203 acts as a buffer to absorb high peaks of voltage induced in the secondary of T201. Resistor R202 limits the current produced by the inductive kick in the vibrator coil when the circuit is opened.

c. Battery Charger. When the charger ac cord is connected to a source of 110-volt, 60-cycle alternating current (ac) and the CHARGER switch is in the ON position, the charger is placed in operation. Fuse 202, rated at 2 amperes, is in the primary circuit for overload protection. Resistor R204 develops a small voltage drop to limit the voltage across the primary of T202. Transformer T202 steps down voltage. The current in the secondary always flows from the grounded center tap through either half of rectifier CR201. The unidirectional outputs of the rectifiers are tied together to produce a full-wave rectifier, the output of which is applied to the storage batteries for charging. The charger on indicator lamp I 201 lights when the battery charger is in operation.

48. Receiver Power Input Circuits
(fig. 38)

When the receiver is connected to the power supply and POWER switch S105 is in the START or ON position, filament power from the batteries is applied through pin A of POWER connector J103 and through the closed contacts of the single-pole, single-throw switch section of S105. Battery power is also fed through pin C to the vibrator in the power supply. The resultant high-voltage output from the vibrator enters through pin B of J201 and is fed to all stages through section 1, front, of POWER switch S105. Resistor R152 drops the input to 150 volts. Tube V110, a type OA2 gas-filled, cold-cathode diode, functions as a voltage regulator. It is connected from the high-voltage line to ground. When voltage tends to rise above 150 volts, V110 draws more current; this increases the voltage drop across resistor R152 and thus maintains the supply to the receiver at 150 volts. The panel pilot lamp, a neon type NE51, is connected to the 150-volt supply when the POWER switch is in the START or ON position. A current-limiting resistor is part of the pilot lamp socket.

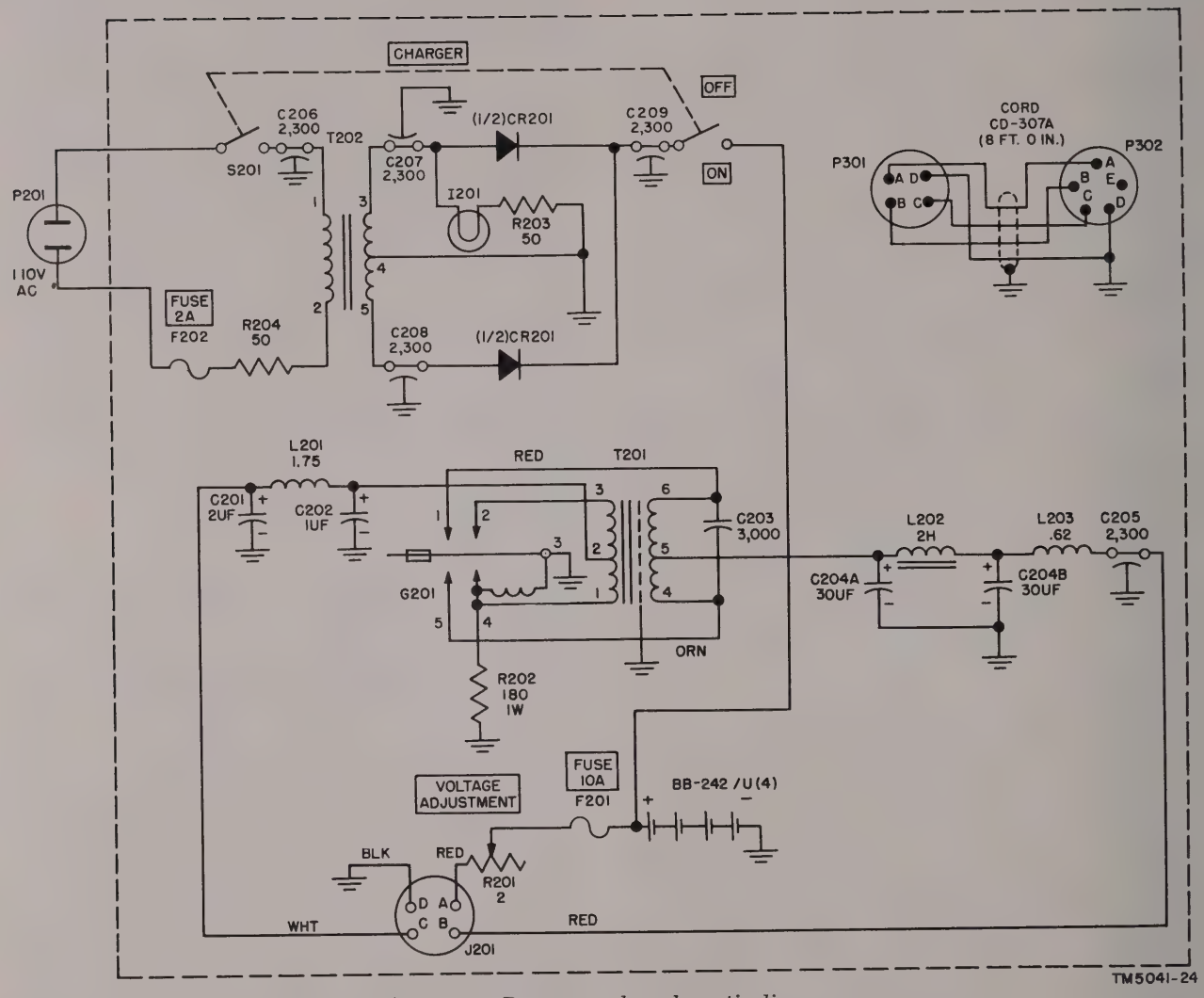


Figure 24. Power supply, schematic diagram.

CHAPTER 6

FIELD MAINTENANCE

Note. This chapter contains information for field maintenance. The amount of repair that can be performed by units having field maintenance responsibility is limited only by the tools and test equipment available and by the skill of the repairman.

Section I. TROUBLESHOOTING AT FIELD MAINTENANCE LEVEL

Warning: Plate and screen circuits are connected to the 150-volt power supply. Do not touch these circuits while power is being applied to the receiver. Be careful when handling or testing any part of the receiver while it is connected to the power supply.

49. Troubleshooting Procedures

a. General. The first step in servicing a defective field-strength meter is to sectionalize the fault. Sectionalization means tracing the fault to the defective component—the power supply, the receiver, or the antenna system. The second step is to localize the fault. Localization means tracing the fault to the stage or circuit where the trouble is located. The third step is to isolate the defective part. Some faults, such as burned-out or cracked resistors, high-voltage arcing, and shorted transformers, often can be located by sight, smell, and hearing. Most faults must be isolated by checking voltage and resistance.

Warning: The failure of selenium rectifiers can result in poisonous fumes and the deposit of dangerous selenium compounds. If a rectifier in the power supply burns out or arcs over, the odor is strong. Provide adequate ventilation at once. *Avoid inhaling the fumes and do not handle the damaged rectifier until it has cooled.*

b. Component Sectionalization and Localization. The group of tests given in (1) through (6) below are designed to systematize troubleshooting, reduce unnecessary work, and aid in tracing a trouble to a specific component. The simple tests are used first. The more detailed tests are used if the first tests do not isolate the trouble. Follow the procedures in the order given.

(1) *Visual inspection.* The visual inspection procedures given in paragraph 28 should be used first to locate any obvious, visible trouble. Through inspection alone the trouble or the defective circuit often can be located.

(2) *Operational check.* Check the field-strength meter under operating conditions by following the procedures in the equipment performance checklist (par. 31). In many cases, the information gained will determine the exact nature of the fault.

(3) *Troubleshooting chart.* The trouble symptoms and corrections listed in this chart (par. 55) will aid greatly in localizing troubles.

(4) *Voltage and resistance measurements.* Further damage to a defective field-strength meter from possible short circuits or overloads can be prevented by measurement of voltages and resistances at the pins of each tube in the equipment. Such measurements also help to locate faulty circuit components. The voltage and resistance diagram (fig. 37) shows the measurements which must be obtained for correct equipment performance. The values given are approximate. They will vary slightly from unit to unit as

a result of resistor tolerances. A check of transformer and coil resistances in a suspected stage (par. 56) will help to isolate the trouble.

(5) *Signal substitution.* The use of a signal generator to inject a signal of correct frequency and amplitude into successive stages will isolate a defective stage. The test equipment required is listed in paragraph 51. Signal substitution procedure is outlined in paragraph 57.

(6) *Intermittents.* In all these tests, the possibility of intermittent conditions should not be overlooked. If present, this type of trouble often may be made to appear by tapping or jarring the equipment. It is possible that some external connection may cause the trouble. Test wiring for loose connections. Move wires and components with an insulated tool, such as a pencil or a fiber rod. This may show where a faulty connection or component is located.

50. Troubleshooting Data

The use of the material supplied in this manual will help in the rapid location of faults. Consult the following troubleshooting illustrations:

Fig. No.	Title
25	Receiver, front panel, location of parts.
26	Receiver, location of parts, top view.
27	Receiver, location of parts, rear view.
28	Receiver, location of circuit components, bottom view.
29	Receiver, location of resistors, tube sockets, and transformers, bottom view.
30	Receiver, interior view of RF, local oscillator, and mixer section.
31	Receiver, interior view of calibrating-oscillator section.
32	Power supply, front panel and batteries, location of parts.
33	Side view of power-supply chassis, location of parts.
34	Bottom view of power-supply chassis, location of parts.
35	MIL STD resistor color codes.
36	MIL STD capacitor color codes.
37	Voltage and resistance diagram.
38	Over-all schematic diagram.

51. Test Equipment Required for Troubleshooting and Alinement

The items of test equipment required for troubleshooting the field-strength meter are listed below. A common name for each item is also listed.

Nomenclature	*Common Name*
RF Signal Generator TS–497/URR	Hf signal generator
RF Signal Generator AN/URM–25D	Signal generator
Audio Oscillator TS–382/U	Audio oscillator
Electron Tube Test Set TV–2/U	Tube tester
Multimeter TS–352/U	Multimeter
Electronic Multimeter TS–505/U	Vtvm

52. General Servicing Precautions

Observe the following precautions when servicing the field-strength meter:

a. Be careful when removing the receiver from the carrying case; high-voltage points are exposed.

b. If the receiver has been operating for some time, use a cloth to remove the metal tube shields and use a tube puller to remove hot or operating tubes.

c. When servicing the RF, mixer, and local-oscillator (fig. 30) or the calibrating-oscillator (fig. 31) sections, do not disturb the placement of parts. Be careful not to bend the tuning capacitor plates; this could cause a short circuit or a change in alinement.

d. Do not attempt to disassemble thermocouple housing TC101 (fig. 26). This is a sealed unit and should be replaced as a whole if found defective.

e. Do not replace individual resistors in the FR, IF, and calibrating-oscillator attenuators. The attenuators use close tolerance resistors and must be replaced as units if found to be defective.

f. When removing the storage batteries in the power supply, first disconnect the end positive and the end negative leads (fig. 32) to disconnect the batteries from the power-supply chassis and case. This eliminates the danger of accidental short-circuiting of the batteries.

g. When changing a component that is held by screws, always replace the lockwashers.

h. Before testing or replacing electron tubes, refer to paragraph 29.

53. Checking Power Supply Circuits for Shorts

Disconnect the power cord from the power supply before making resistance measurements.

a. The battery voltage input to vibrator G201 is from pin C on connector J201. Remove the vibrator and measure the resistance from pin C to the chassis. Normal resistance should be 180 ohms; a lower reading indicates a leaking or shorted filter capacitor C201 or C202.

b. The high-voltage output to the receiver is at pin B of J201. A reading of at least 50,000 ohms should be obtained from pin B to ground. A lower reading indicates a leaking or shorted electrolytic filter capacitor C204A or C204B.

c. If a short persists, remove the power-supply chassis from the case (par. 72*c*). Inspect all components visually. Measure resistance across terminals 4 and 6 of vibrator transformer T201 for the correct value of 200 ohms. A lower resistance indicates a shorted C203 or a defective transformer.

d. Measure resistance across the prongs of the battery charger cord for the correct value of 58 ohms. If a different reading is obtained, check resistor R204 and measure the resistance of the primary of transformer T202 for a value of 8 ohms. Check fuse F202.

54. Checking Receiver Heater and High-voltage Circuits for Shorts

Disconnect the power cable from the receiver before making resistance measurements.

a. Heater Circuits. The 6-volt heater circuit enters the receiver at pin C of POWER connector J102. All tube heaters are connected in parallel between the heater line and ground. To check for shorts, remove all tubes; then measure the resistances to ground from pin C of J102, the contacts of switch S105, and the heater pins of each tube socket.

b. High Voltage. The high-voltage output from the vibrator power supply enters the receiver at pin B of POWER connector J103 (fig. 38). Resistor R152 drops the voltage to 150 volts at the plate of voltage regulator V110. Any defective component in one stage, such as a shorted decoupling capacitor, will lower the B voltage in all stages.

(1) Disconnect the power cord at the power supply and place a short across pins A and C of connector J201. This applies battery voltage directly to the vibrator and, at the same time, eliminates the possibility of defective circuits affecting the output of the vibrator. Measure the voltage between pin B of J201 and the power-supply chassis. Normal voltage is 157.5 volts. Low output voltage indicates trouble in the power supply. A normal output voltage indicates that the fault is in the high-voltage circuits of the receiver.

(2) High-voltage circuit checks in the receiver can be made from the bottom of the receiver chassis. Remove the side covers from the RF, local-oscillator, mixer shield or from the calibrating-oscillator shield to reach the tube sockets in those circuits. Measure the resistance to chassis ground from the plate and screen-grid pins of each tube, as shown on the schematic diagram (fig. 38). The readings should agree with those on the voltage and resistance diagram (fig. 37). If the readings in any stage are incorrect, the defective component in that stage can then be isolated.

55. Troubleshooting Chart

The following chart lists symptoms of trouble, with the probable cause and the remedy for each.

Symptom	Probable trouble	Correction
1. POWER switch in START position, all receiver tube heaters and panel lamp fail to light, no vibrator buzz; with CALIBRATE SWITCH S106 in FIL position, no indication or low indication on calibration meter.	Blown fuse F201	Replace fuse.
	Dead storage batteries	Recharge or replace batteries.
	Defective VOLTAGE ADJUSTMENT control R201.	Repair or replace R201.
	Defective power cord or connectors	Repair or replace cord or connectors.
	Defective POWER switch S105	Repair or replace S105.
	Defective or dirty storage battery connections.	Clean storage battery terminals and connections. Replace connectors if necessary.

Symptom	Probable trouble	Correction
2. Fuse F201 blows repeatedly	Defective receiver power cord	Check for shorts between wires with ohmmeter; repair or replace.
	Shorted capacitor C201, C202, C203, C204A, or C204B.	Check each capacitor with ohmmeter; replace shorted capacitor.
	Short in high-voltage circuit	Refer to paragraphs 53 and 54.
	Defective vibrator	Replace vibrator.
3. POWER switch in START position, tube heaters light; CALIBRATE SWITCH S106 in FIL position, needle at red line on calibration meter, no panel light, no vibrator buzz; CALIBRATE SWITCH in PLATE position, little or no indication on calibration meter.	Defective vibrator	Replace vibrator.
	Transformer T201 open between terminals 1 and 2 or 2 and 3.	Repair or replace T201.
	Choke L201 open	Repair or replace L201.
	Defective power cord or connector	Repair or replace power cord or connector.
	Defective POWER switch S105	Repair or replace S105.
4. Needle of M102 indicates below red line when CALIBRATE SWITCH S106 is in PLATE position.	Storage batteries low	Charge storage batteries.
	Defective vibrator	Check and replace vibrator.
	Shorted C203	Check C203 and replace if necessary.
	Short circuit, open, or leakage in high-voltage circuits of receiver.	Check receiver high-voltage circuits (par. 54).
5. Needle of meter M102 indicates above red line when CALIBRATE SWITCH S106 is in PLATE position.	V110 defective	Replace V110.
6. Signal level meter cannot be zeroed with POWER switch in START position.	Poor contact made in RECORDER OUTPUT jack J102.	Clean contacts and check spring tension in J102; replace jack if necessary.
	Defective POWER switch S105	Repair or replace S105.
	Defective tube V108	Test V108; replace if necessary.
	Resistor R141, R140, R143, or R144 open or changed value.	Measure resistors with ohmmeter; replace if necessary.
	Capacitor C142B or C142C defective	Check capacitors; replace if necessary.
	Primary of T108 open	Repair or replace T108.
	Defective FM DISCRIMINATOR switch S103.	Repair or replace S103.
7. With POWER switch in ON position, noise heard in headset but no indication on signal level meter M101.	Defective M101	Check M101.
	Shorted C142C	Check and replace.
8. With POWER switch in ON position, signal level meter M101 will not zero.	Same as item 6	Same as item 6.
	Low or defective bias battery BT101	Replace bias battery (fig. 7).
	Defective ZERO ON control R142	Check R142 and replace if necessary.
9. Receiver zeroed in ON position of POWER switch, but no background noise or signal in headset.	Defective AUDIO OUTPUT jack J104	Check J104 for continuity.
	Defective if amplifier tube V107, V106, V105, or V104. Defective RF or mixer stage.	Touch grids of tubes to locate defective tube. Test and replace tube. Make voltage and resistance measurements (fig. 37). Use signal substitution (par. 57) to locate faulty stage.
	Open ZERO switch S101	Check continuity of S101.
	Defective RF or IF attenuator Z101	Check and replace attenuator Z101, if necessary.
10. Background noise but no audio signal in headset with ATTENUATOR control at 0 or 14.	Faulty antenna cable connections	Clean or repair faulty antenna connections.
	Loose cables at PUSH TO CAL. switch S107 or defective S107.	Check cable connections or check S107 and replace if necessary.
	Antenna mounting head defective	Measure from each antenna head connector pin to each dipole stub for 11-ohm resistance.
	Weak tube	Test all tubes.
	Dirty tuner turret contacts or wipers	Clean turret contacts or wipers.

Symptom	Probable trouble	Correction
	Defective local-oscillator tube V102	Test V102. Make voltage and resistance measurements of stage.
	Shorted C116 or C117	Replace C116 and C117 if defective.
	Open OUTPUT switch S104	Check S104.
	Open RESPONSE switch S102	Make continuity checks. Check S102 linkages. Tighten set screws on shafts. Replace IF transformer if any part of S102 is defective.
11. No signal with FM DISCRIMINATOR switch in ON position.	See item 10	See item 10.
	Open FM DISCRIMINATOR switch S103.	Check continuity of S103.
	Defective crystals CR101 and CR102	Check crystals. Forward resistance should be at least 10 times reverse resistance.
	Weak or defective bias battery BT101	Replace BT101.
12. Weak AM or FM signal	See items 10 and 11	See items 10 and 11.
	Dipole wrong length for frequency received.	Adjust dipole length with megacycle rule.
	Dipole facing in wrong direction	Rotate dipole until signal increases.
	Defective stage	Make voltage and resistance measurements (fig. 37).
	IF amplifiers out of alinement	Aline IF amplifiers; refer to paragraph 74.
	RF amplifier or local oscillator out of alinement.	Aline (par. 75).
13. Erratic signal	Dirty contacts or bad fit between tube pins and sockets.	Clean and repair contacts.
	Defective antenna cable, shielding, or connectors.	Repair antenna cable.
	Loose tube element	Tap tubes to locate defective one.
	Dirty or defective GAIN control R129	Repair or replace R129.
	Loose connection or circuit part	Inspect visually. Make voltage and resistance measurements.
	Dirty tuner turret contacts or wipers	Clean turret contacts and wipers.
14. Incorrect attenuator reductions observed on meter when ATTENUATOR control settings are varied.	Defective attenuator gears, cams, plungers, or networks.	Replace attenuator (par. 67).
15. No signal when OUTPUT switch is thrown to LOG position.	Open OUTPUT switch S104	Check S104.
	Defective log-centering control R135	Check R135.
16. No signal when RECEIVER BAND SELECTOR is rotated to another band.	Dirty or defective tuner turret contacts or wipers.	Clean or repair turret contacts or wipers.
	Dipole length wrong for frequency received.	Adjust dipole length with megacycle rule.
17. Signal does not peak when RF TRIMMER control is rotated.	Flexible shaft loose or defective	Tighten or replace flexible shaft.
	Defective connections at C108A and C108B.	Repair connections at C108A and C108B.
18. Audio signal distorted	ATTENUATOR setting too low	Turn to higher attenuation position.
	Bias battery BT101 weak.	Replace BT101.
19. RF, mixer, and local-oscillator tubes (V101, V102, and V103) inoperative.	Broken or defective C103 or C111 if heaters do not light.	Replace C103, and C111, if necessary.

Symptom	Probable trouble	Correction
	Broken or defective C105 or C113 if no plate voltage.	Replace C105, and C113, if necessary.
20. Calibration meter M102 indicates calibrating-oscillator output, but no input to receiver observed on meter M101 when PUSH TO CAL. switch is pushed.	Loose or defective cable connections at PUSH TO CAL. switch S107, attenuator Z103, or rf attenuator Z101A.	Check and repair cable connections.
	Open PUSH TO CAL. switch S107	Repair or replace S107.
	Defective calibrating-oscillator attenuator Z103.	Replace Z103; housing also includes thermocouple TC101.
	Defective receiver stage	See items 9, 10, 12, 16, and 18.
21. Calibrating-oscillator operative, input to receiver indicated, but no indication on calibration meter M102.	CALIBRATE SWITCH S106, section 1 rear, defective.	Check continuity through S106.
	Feed-through capacitor C176 on thermocouple housing broken or defective.	Check and replace C176 if necessary.
	Resistor R155 defective	Check and replace R155 if necessary.
	Thermocouple TC101 defective	Replace TC101 and reset R155 for red-line indication (par. 68 and 79).
	Calibration meter M102 defective	Check meter movement.
22. Calibrating-oscillator inoperative, no indication on calibration meter M102 when S106 is in ON CAL OSC position, no input to receiver.	Defective V109	Test and replace V109 if necessary.
	Broken or defective C169 if heater of V109 does not light.	Check C169.
	Broken or defective C171 if no plate voltage on V109.	Check and replace C171.
	Dirty or defective tuner turret contacts or wipers.	Clean or repair turret contacts or wipers.
	OSCILLATOR OUTPUT control R154 open or defective.	Check and replace R154.
	CALIBRATE SWITCH S106, section 2 rear, segments Y or Z defective.	Check S106.
23. Calibrating-oscillator output weak, needle will not reach red line on meter M102 when OSCILLATOR OUTPUT control is rotated.	Weak V109.	Test V109.
	Short or leakage in high-voltage circuits.	Check high-voltage circuits for shorts (par. 54).

56. Dc Resistances of Transformers and Coils

The dc resistances of transformers and coils are listed below. Unlisted transformers and coils have negligible resistances.

Transformer	Terminals	Ohms
T108	Primary wires: blue and red	1,000.
	Secondary wires: yellow and green	50.
T201	1–3	Less than one.
	1–2 or 2–3	Less than one.
	4–6	200.
	4–5 or 5–6	100.
T202	1–2	11.
	3–5	0.5
	3–4 or 4–5	0.25
L202		75.
L105		100.

57. Signal Substitution Notes

For detailed information on signal substitution and signal tracing, refer to paragraphs 58 through 65.

a. An audio oscillator and signal generators (par. 51) provide signals of proper voltage and frequency that are to be substituted in, or traced through, the receiver. For signal substitution procedures that require an RF input at the antenna, the output impedance of the signal generator must match the 95-ohm balanced input of the receiver. If a 92-ohm balanced-output signal generator is used, its output can be connected directly to the antenna cable or to the ANTENNA connector on the front panel of the receiver. If a signal generator with a 50-ohm coaxial output is used, it must be connected through Impedance Matching Net-

work CU–504/URM–91 and the antenna cable to the ANTENNA connector. The impedance-matching network adds 50 ohms in series with the signal generator output, and thus provides an approximate match to the 95-ohm balanced input of the receiver. (The foregoing information applies also to alinement procedures.) The impedance-matching network is stored in the cover of the antenna case (fig. 5).

b. A method is required to observe, measure, or listen to the output of the circuit being tested. Most indications can be read on receiver meters M101 and M102. In addition, a headset may be used to listen to the signal.

Note. Do not remove shield cans or other shielding until the trouble has been traced to a particular unit. Do not push wiring out of place; this may cause broken connections, change the frequency of an oscillator, or alter the characteristics of a circuit.

c. When connecting a signal generator to the grid of a tube, be sure that the low-impedance output of the signal generator does not short the grid voltage in the circuit under test. Connect a .01-microfarad (μf) capacitor in series with the output (high side) of the signal generator.

d. Once the trouble is traced to a stage or circuit, make tube tests and voltage and resistance measurements (fig. 37) to locate the defective part.

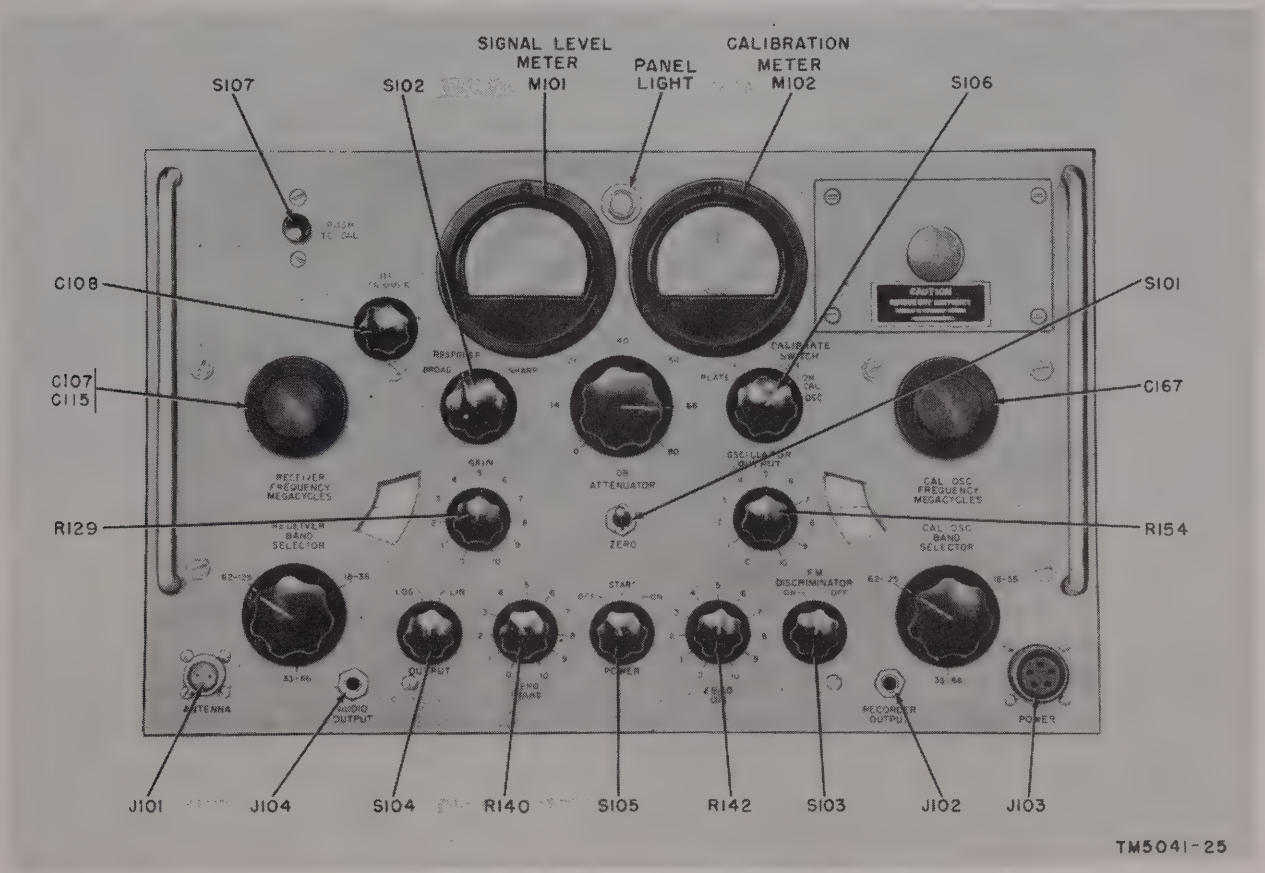


Figure 25. Receiver, front panel, location of parts.

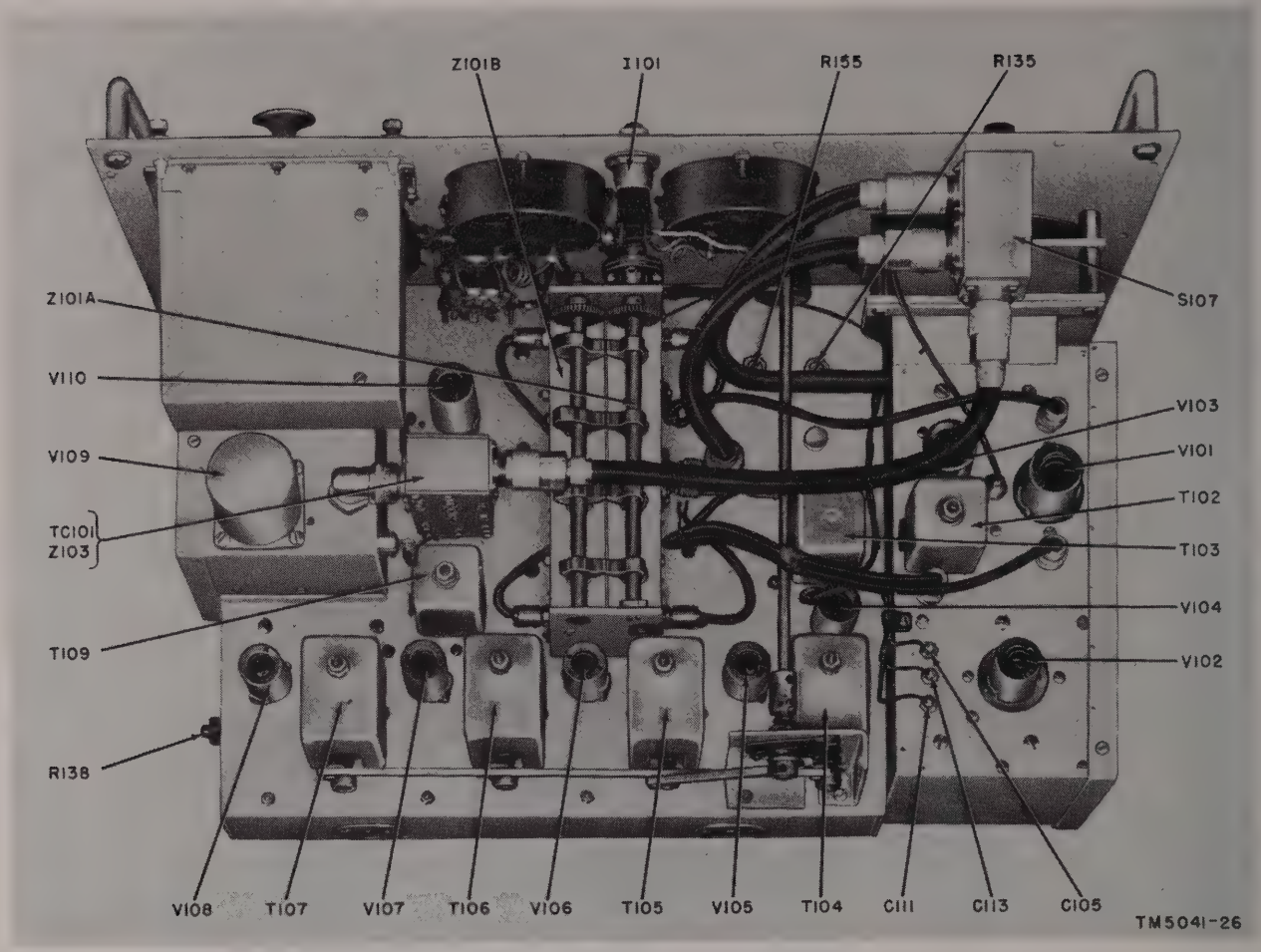


Figure 26. Receiver, location of parts, top view.

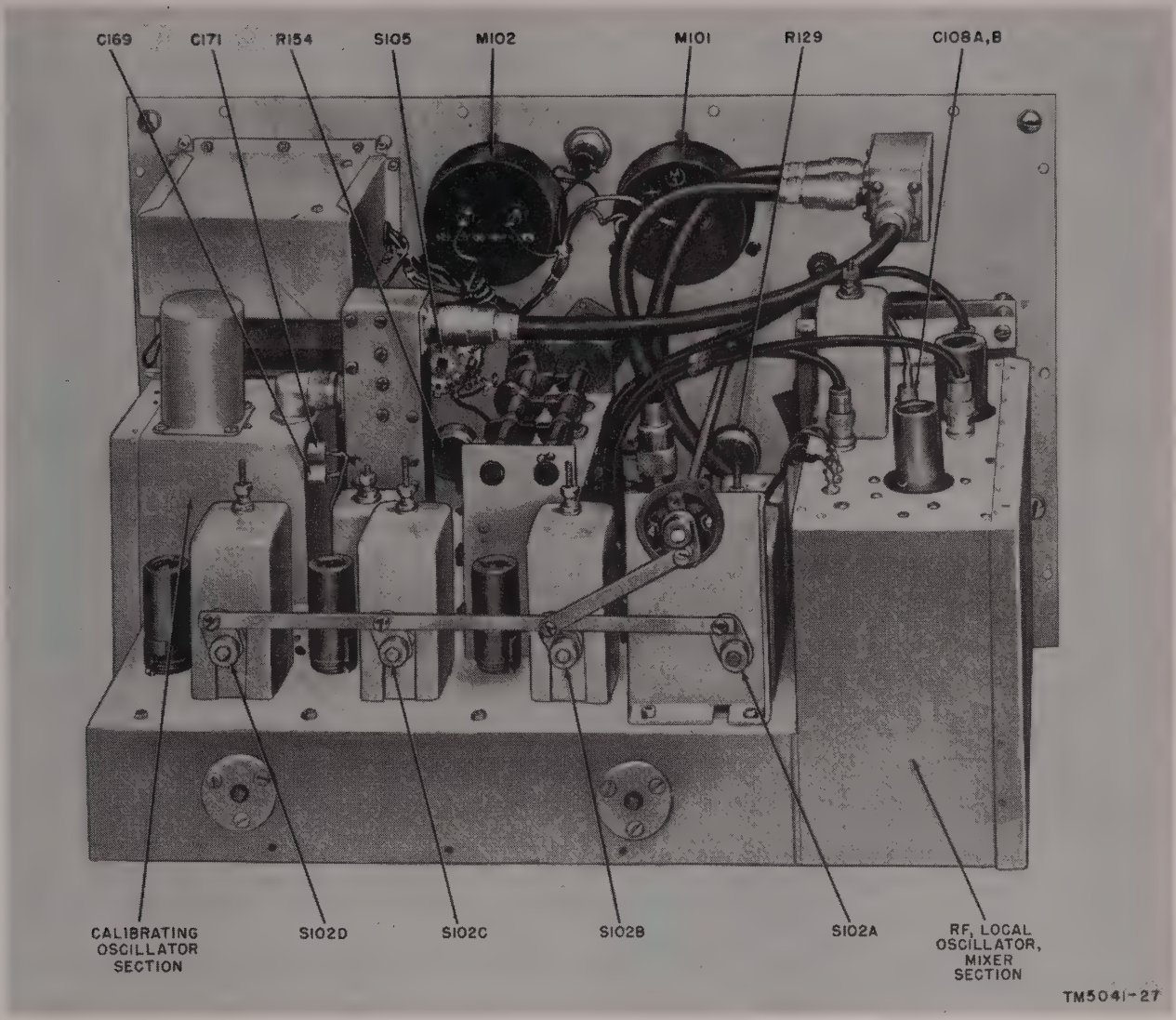


Figure 27. Receiver, location of parts, rear view.

58. AM Detector and Audio Amplifier

a. Connect the receiver to the power supply and perform the starting procedure given in paragraph 16.

b. Set the CALIBRATE SWITCH to the OFF position. Settings of the other controls will not affect this test.

c. Plug the headset into the AUDIO OUTPUT jack.

d. Adjust the audio oscillator for an output of 1,000 cycles at 10 volts and apply it to the plate of V108 (pin 7). A signal should be heard in the headset. Connect the same generator output to the grid (pin 1) of V108. The signal should increase and meter M101 should show an indication of about 1 microvolt. If it does not, refer to the troubleshooting chart (par. 55).

e. Adjust the frequency of the signal generator to 10.7 mc, amplitude-modulated at 1,000 cycles, and connect the output to the diode plates (pin 5 or 6) of V108. The signal level meter should indicate output and a signal should be heard in the headset. If a signal is heard but no indication appears on the meter, the fault is in the meter or its circuit. If no signal is heard, refer to the troubleshooting chart (par. 55). Measure voltages and resistances (fig. 37).

59. FM Discriminator

a. Turn the FM DISCRIMINATOR switch to the ON position. Turn the CALIBRATE

SWITCH to the OFF position. Settings of the other controls will not affect this test.

b. Adjust the signal generator for a 100-millivolt output at 10.7 mc, frequency-modulated at 1,000 cycles. Connect the output to the plate of fourth IF amplifier V107 (pin 5).

c. Listen for a signal in the headset. If no signal is heard, the fault is in the FM discriminator circuit. Refer to the troubleshooting chart (par. 55).

60. IF Amplifiers

a. Turn the FM DISCRIMINATOR switch to the OFF position. Turn the CALIBRATE SWITCH to the OFF position. Set the GAIN control at 0. Return the adjustment of the signal generator to amplitude modulation, 1,000 cycles, 100 millivolts. Apply the signal generator output to pin 5 (plate) of V107. Listen for a signal in the headset and note the position of the needle on M101. Apply the same output of the signal generator to pin 1 (control grid) of V107. The signal in the headset and the indication on M101 should increase.

b. Vary the GAIN control. The reading on meter M101 should also vary. Press the ZERO switch; the reading on M101 should drop to 0 microvolt.

c. If the fourth IF amplifier operates satisfactorily, continue to apply the 10.7-mc generator output to the plates and then to the grids of the third, second, and first IF amplifiers. The signal should increase at each plate and increase further at each grid. Reduce the signal generator output at each step to obtain an on-scale reading on meter M101. With the GAIN control set at 10, an input of 1 millivolt on the plate, or 10 microvolts on the control grid of V104, will normally produce a full-scale deflection of meter M101.

d. When testing second IF amplifier V105, switch from the LIN to the LOG position of the OUTPUT switch. The signal should decrease. If it does not decrease, bias battery BT102 is low or defective. Switch back to the LIN position for further tests.

e. If a faulty IF stage is localized, consult the troubleshooting chart (par. 55). If the trouble is not evident, measure voltages and resistances (fig. 37).

61. Mixer and IF Attenuator

a. Remove the side plate from the RF, local oscillator, and mixer section (fig. 30). Connect the 10.7-mc modulated signal generator output, about 10 microvolts, at a plate (pin 1 or 6) of mixer V103. Start with the GAIN control at the 0 position; increase it until a midscale reading is obtained on meter M101. Listen for a signal in the headset. First set the ATTENUATOR control at the 0 db position. Reset the ATTENUATOR to the 14, 26, 40, and 54 db positions, increasing the signal generator output as necessary to obtain an on-scale reading on meter M101. If no signal is obtained at any one of the attenuation steps, intermediate frequency attenuator Z101B is faulty, and the entire attenuator assembly must then be replaced (par. 67).

b. Connect the 10.7-mc signal, about 5 microvolts, to a grid of V103 (pin 2 or pin 7). The signal should be stronger. If no signal is obtained, test tube V103. Refer to the troubleshooting chart (par. 55). If necessary, make voltage and resistance measurements (fig. 37).

62. RF Amplifier

a. Adjust the signal generator for a 5-microvolt output at 20 mc, amplitude-modulated at 1,000 cycles. Set the RESPONSE switch at the SHARP position. Tune the receiver to the same frequency as the signal generator.

b. Apply the output of the signal generator to pin 1 of V101. Listen for the signal in the headset and observe meter M101 for an output.

c. Apply the same signal generator output to pin 3 of V101; the signal should increase.

d. Repeat the procedures given in *b* and *c* above, applying the signal generator output to pins 6 and 8 respectively.

e. Repeat the procedures given in *b* through *d* above for each of the other two frequency bands; use a suitable test frequency in each band.

f. If no output is obtained, first test for local-oscillator output by connecting the probe of the vtum through a .01-μf capacitor to the plate of V102 (pin 1 or 5). Set the vtvm on the ac scale. If output is obtained from the local oscillator, the RF amplifier may be at fault or the local oscillator may be out of alinement.

63. Local Oscillator

If the procedures in paragraph 62 have localized the trouble to the local oscillator, and if the calibrating oscillator and the RF attenuator are

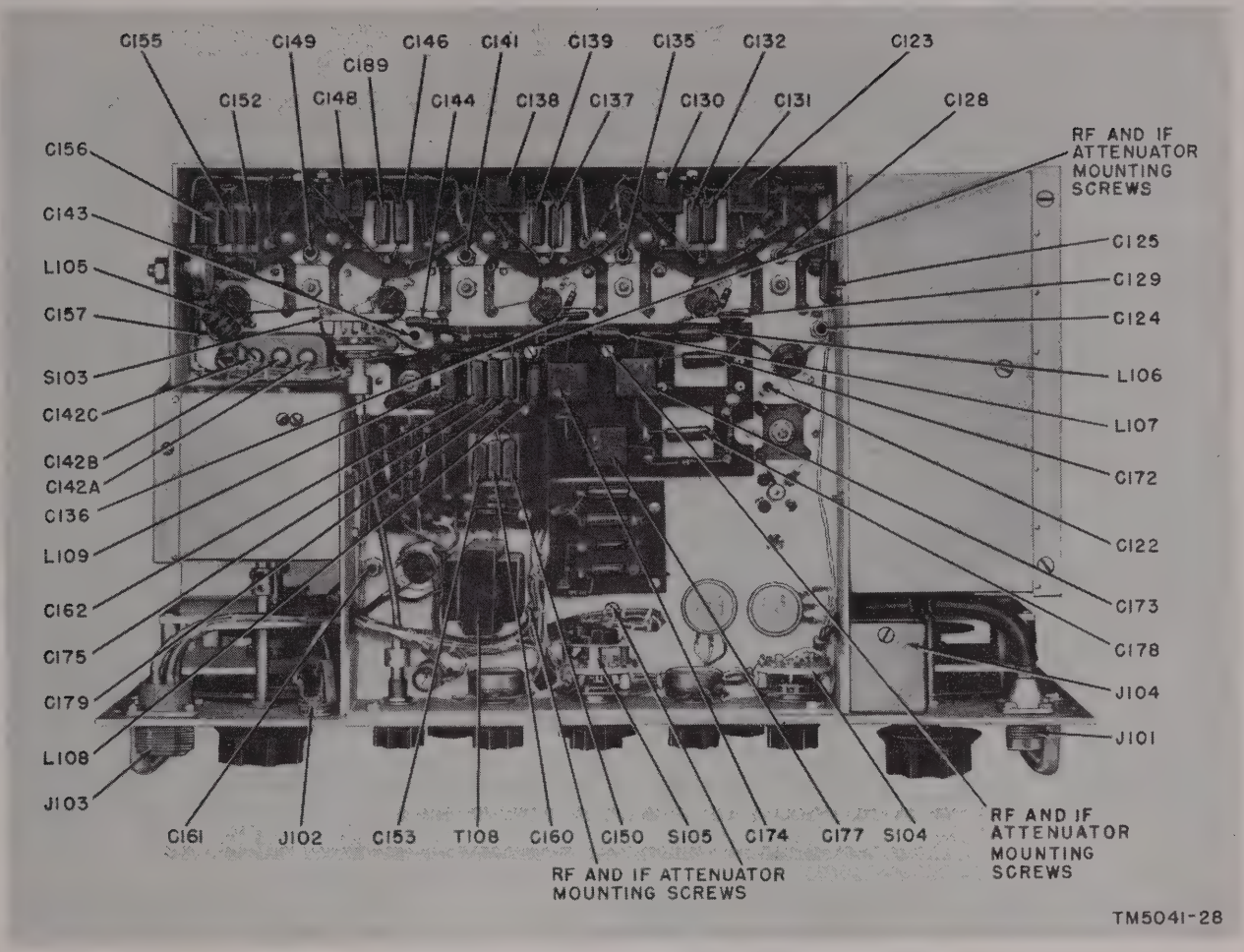


Figure 28. Receiver, location of circuit components, bottom view.

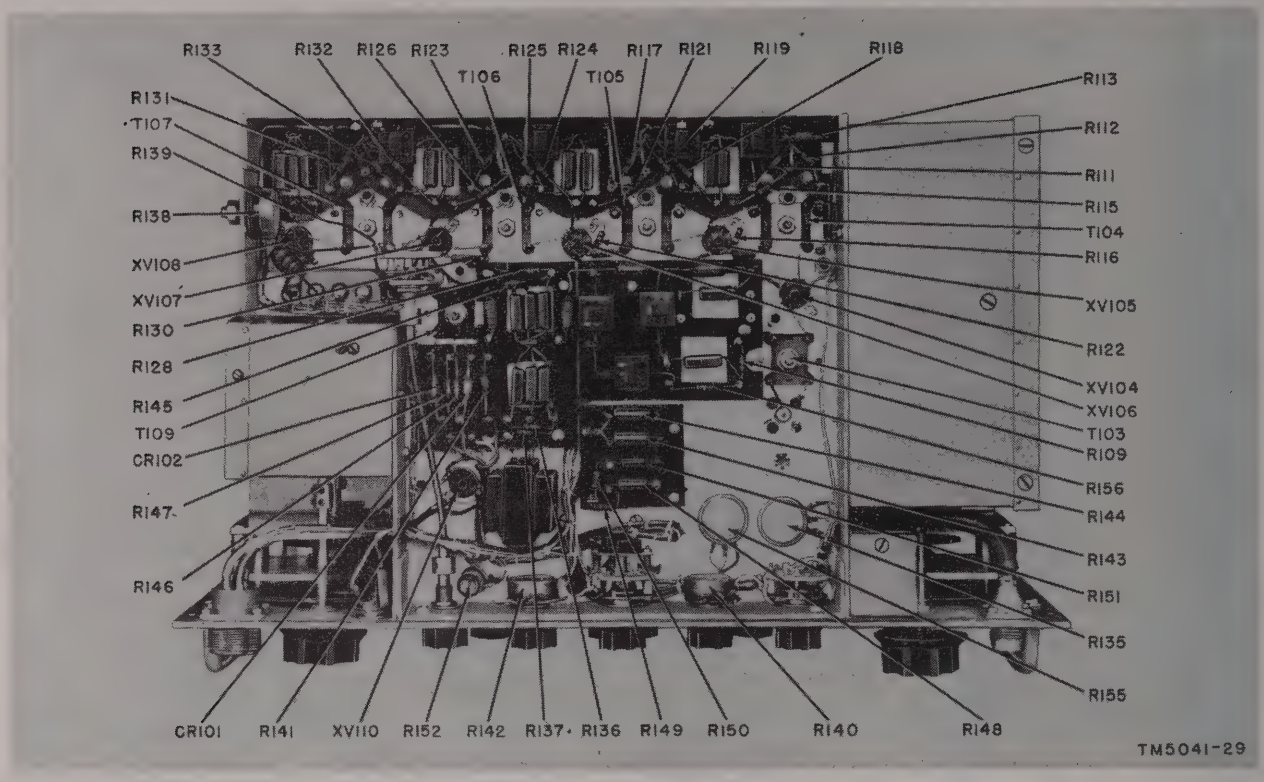


Figure 29. Receiver, location of resistors, tube sockets, and transformers, bottom view.

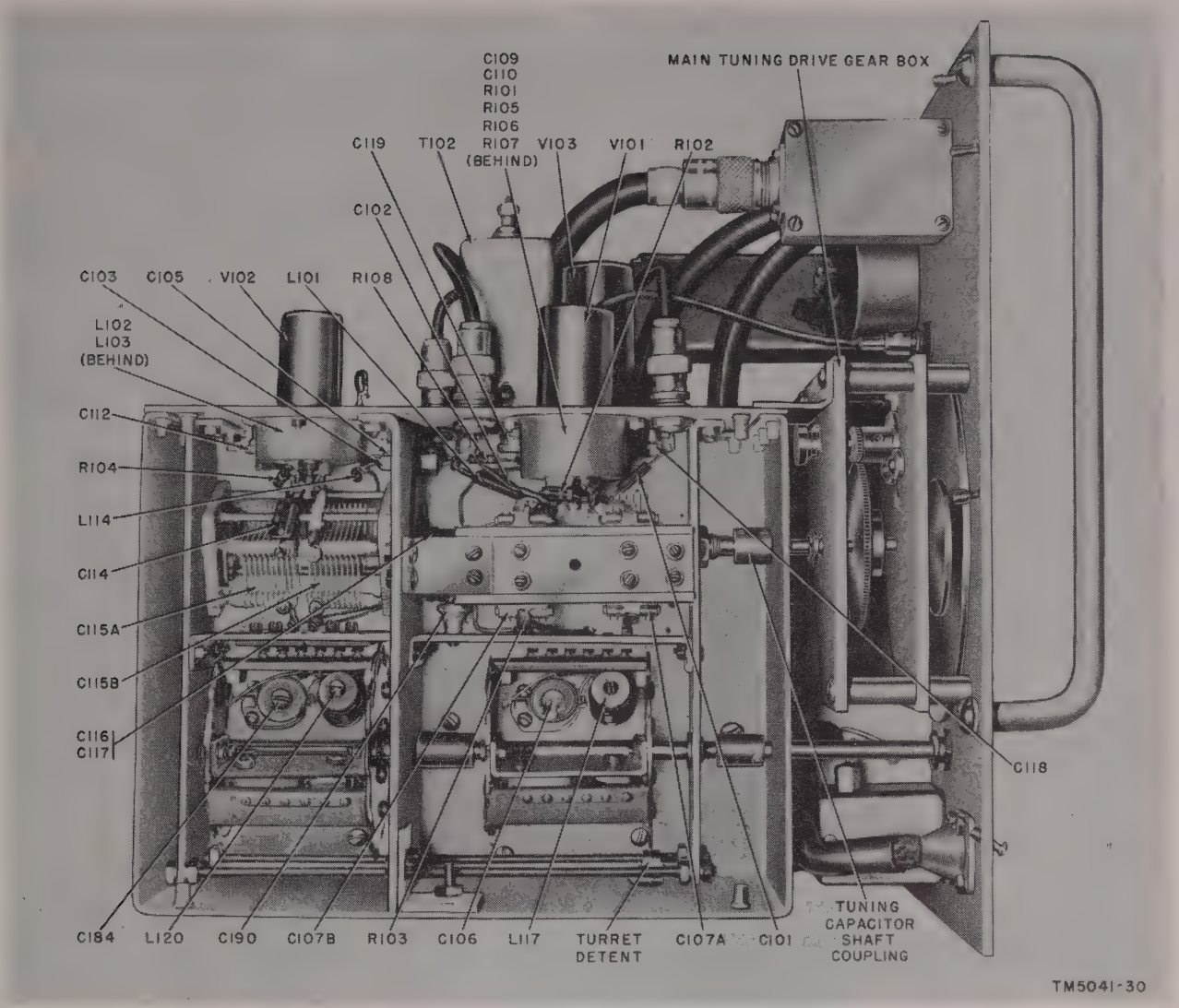


Figure 30. Receiver, interior view of RF, local oscillator, and mixer section.

known to be operative, perform the following test:

a. Set both the RECEIVER BAND SELECTOR and the CAL OSC BAND SELECTOR to the 18–35 mc band. Set the GAIN control at 10.

b. Tune both receiver and calibrating oscillator to 20 mc. Adjust the signal generator to exactly 30.7 mc, amplitude-modulated at 1,000 cycles at an output level of about 5 microvolts.

c. Apply the signal generator signal output to the plate of V102 (pin 1 or pin 5).

d. Press and hold in the PUSH TO CAL. switch.

e. Listen for the signal in the headset and observe meter M101 for output.

f. Repeat the procedures given in *a* through *e* above in each of the other two frequency bands.

g. If signal output is observed, the local oscillator is either defective or out of alinement. Refer to the troubleshooting chart (par. 55) or measure voltages and resistances (fig. 37). If the local oscillator is operating, it is probably out of alinement; refer to paragraph 75.

64. RF Attenuator

a. Remove the cable connection that leads from attenuator Z101A to PUSH TO CAL. switch S107 (fig. 26).

b. Set the RECEIVER BAND SELECTOR to the 18–35 position. Tune the receiver to 20 mc.

c. Adjust the signal generator frequency to 20 mc, amplitude-modulated at 1,000 cycles, at an output level of about 5 microvolts, and apply the output between ground and one of the pins in the exposed connector on the RF attenuator.

d. Set the ATTENUATOR control to the 80 db position. Receiver output should be heard and observed on meter M101. Increase the signal generator output for an on-scale reading, if necessary. Reset the ATTENUATOR to the 66 db position, reducing the signal generator output as necessary.

e. Repeat the procedure in *d* above with the output of the signal generator connected to the other pin in the connector.

f. No receiver output indicates a defective RF attenuator section, if all previous stages have been checked.

65. Calibrating Oscillator

a. Remove the side plate from the calibrating-oscillator section shield (fig. 31).

b. Set the RECEIVER BAND SELECTOR to the 18–35 position. Tune the receiver and the calibrating oscillator to 20 mc.

c. Adjust the signal generator frequency to 20 mc (unmodulated) at an output level of 1 millivolt.

d. Connect the signal generator output to the plate (pin 1 or 5) of V109. Increase the signal generator output to a maximum of 10 millivolts.

Caution: Do not increase the output of the signal generator beyond 10 millivolts; the thermocouple may become damaged by a greater output.

e. Press the PUSH TO CAL. switch. Observe meter M101 for output.

f. If an output is obtained, the calibrating oscillator is defective (assuming that there was no output previously). Refer to the trouble-shooting chart (par. 55). If necessary, measure voltages and resistances (fig. 37).

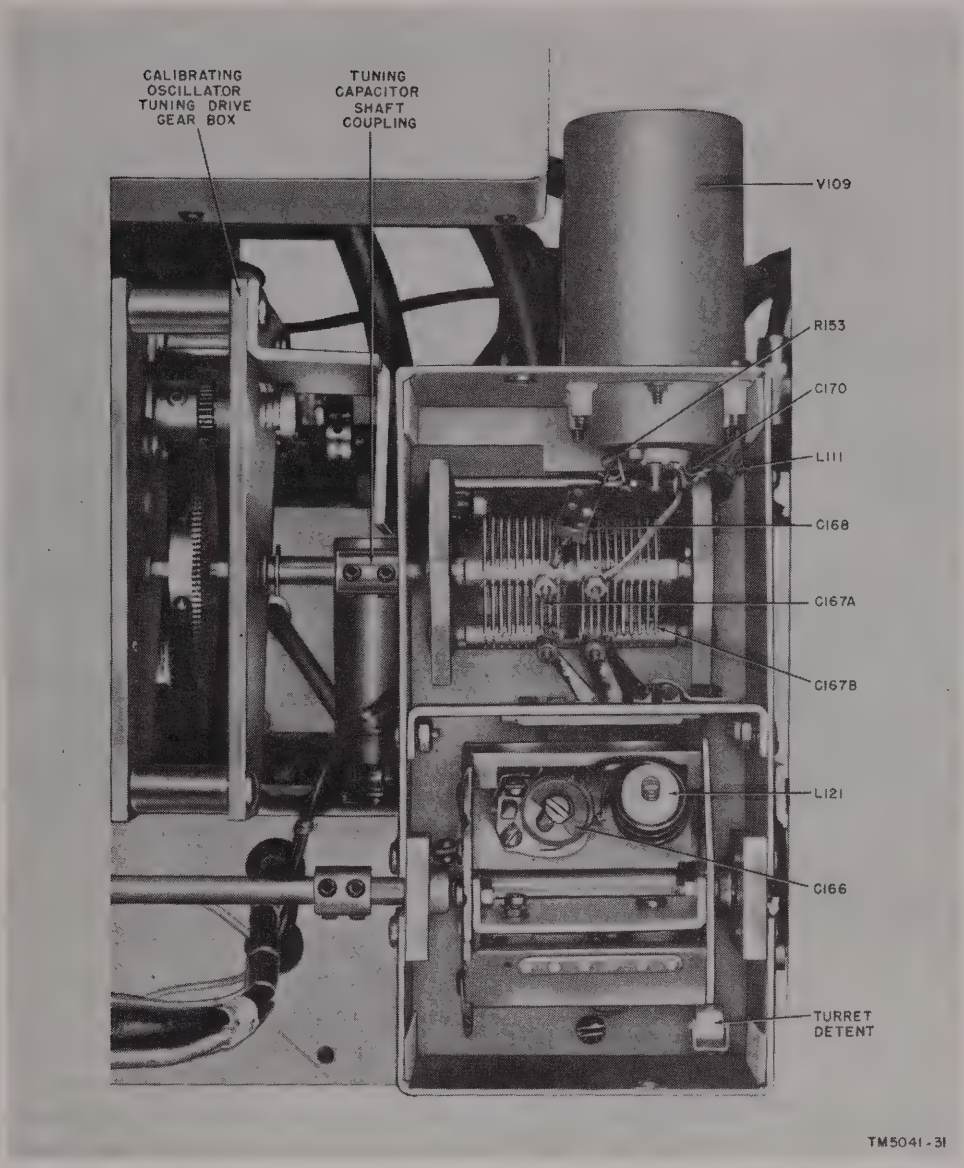


Figure 31. Receiver, interior view of calibrating-oscillator section.

Section II. REPAIRS

66. Replacement of Parts in Receiver

a. Most components of the receiver are readily accessible and are easily replaced by using common tools. Certain components, such as the RF and IF attenuator assembly, the thermocouple and calibrating-oscillator attenuator assembly, the PUSH TO CAL. switch, and the IF transformers, include high-precision parts that are positioned with great accuracy. These components should not be disassembled or repaired in the field, but should be removed and replaced as units. Instructions for their removal are given in paragraphs 67 through 70. The tuning drive gearboxes should not be disassembled if they become defective; they should be removed and replaced as units.

b. The receiver chassis is removed from the case by loosening the 14 captive screws along the edges of the front panel and 2 screws on the rear. The spare tubes, stored in a compartment inside the case, are then accessible.

c. All control knobs on the front panel are fastened to the shafts by set screws and can be easily removed for repairs or replacement.

When removing a knob, make a note of the position of the pointer and shaft and replace the knob in the same position.

d. The side plate for the RF, local oscillator, and mixer section shield (fig. 27) is removed by removing four screws. The side plate for the calibrating-oscillator section shield (fig. 27) is removed by removing two screws.

e. If switches S105 and S106 (fig. 25) require replacement, carefully mark the wires connected to the switch sections to avoid wiring errors.

67. Removal of RF and IF Attenuator Assembly Z101
(fig. 26)

a. Disconnect all cables from the Z101 assembly.

b. Remove the four screws from the coupling flange of the ATTENUATOR control shaft.

c. Remove the two screws from the bottom of the chassis; these screws are visible through the holes in the terminal boards (fig. 28). Remove the other two screws, near the POWER switch, which hold the attenuator assembly in place.

68. Removal of Thermocouple-attenuator Assembly TC101–Z103
(fig. 26)

a. Unsolder the connection to feed-through capacitor C176.

b. Disconnect the cable that leads to PUSH TO CAL. switch S107.

c. From the bottom of the chassis, remove the two screws that hold the mounting bracket of the thermocouple housing.

d. Unscrew the knurled nut of the L connector leading to the calibrating-oscillator section. This connector is shown in figure 26, between V109 and the TC101–Z103 shield.

69. Removal of PUSH TO CAL. Switch

a. Loosen the set screw and remove the knob of the switch.

b. Disconnect the three cables that are connected to S107 (fig. 26).

c. Remove the two flathead screws from the front of the receiver panel to free the switch.

70. Removal of IF Transformers

Note. If any section of RESPONSE switch S102 proves defective, the entire IF transformer in which it is located must be replaced.

a. Remove the screw and hexagonal nut that fasten the short linkage of the IF transformer to the horizontal ganging linkage of S102A through S102D (fig. 27).

b. Unsolder all connections to the transformer at the bottom of the chassis.

c. Remove the four screws that fasten the IF transformer to the chassis.

d. Loosen the set screw that fastens the short linkage to the shaft on the IF transformer. Remove the linkage and keep it for reassembly to the replacement IF transformer.

e. When replacing the RESPONSE switch linkage, be sure that the switch shaft on the replacement IF transformer is in the same position as the shafts of the other IF transformers. When the switch panel knob is in the BROAD position, all shafts must be at the left, or counterclockwise, position as viewed from the rear of the chassis.

71. Removal of Tuning Drive Gearboxes
(figs. 30 and 31)

a. Remove the side panel of the RF or the calibrating-oscillator section shield, depending on the gearbox to be removed.

b. Loosen both set screws on the tuning capacitor shaft coupling with a No. 6 Allen wrench. Slide the coupling off the gearbox shaft.

c. Remove the tuning knobs by loosening the set screws that fasten them to the shaft.

d. Remove the two screws that fasten the gearbox to the mounting bracket.

e. Remove the three flathead screws from the front panel to free the gearbox. Remove the spacing posts between the front panel and the gearbox, slide the gearbox toward the front panel, and remove the gearbox. Do not damage the tuning dial that is attached to the gearbox shaft.

72. Removal of Parts in Power Supply

a. To remove vibrator G201 (fig. 32), pull up on the post end of the retainer and remove the retainer. Withdraw the vibrator from the socket.

b. To remove the storage batteries, first disconnect the end poles and all battery jumper cords. Remove the four hexagonal nuts that fasten the battery mounting strap. Loosen the cable clamps that secure the battery breather tubes and withdraw the tubes from the holes

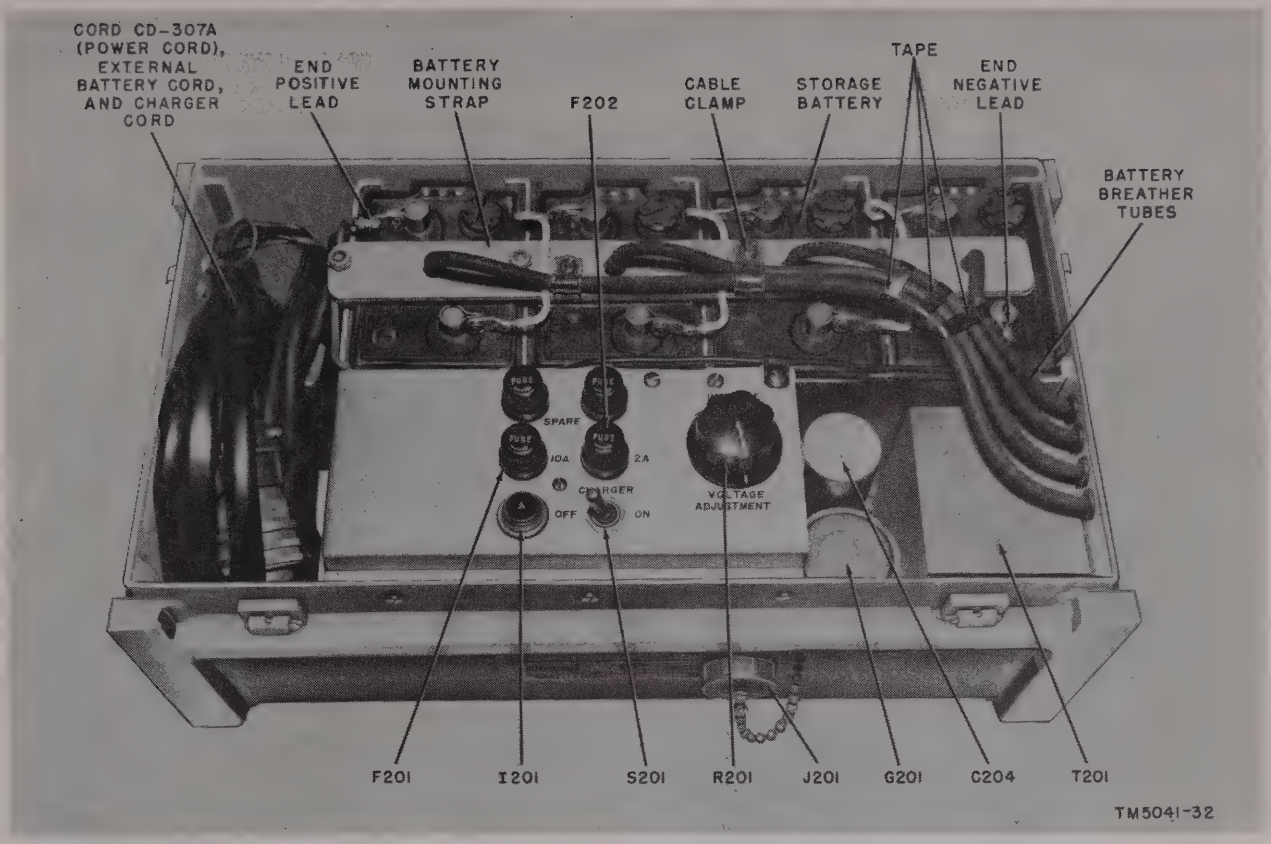


Figure 32. Power supply, front panel and batteries, location of parts.

in the battery mounting strap. Remove the battery mounting strap.

c. To remove the power-supply chassis from the case, remove the three screws (on the top control panel) that are nearest the storage batteries, three screws on the side of the case above the connector, and the eight screws on the bottom of the case. Loosen connector J201 (fig. 32) by removing the cap and the four screws that fasten the connector to the case. Push the connector inside the case. Disconnect the end positive and the end negative leads. The chassis is then free and can be removed from the case.

73. Adjustment of Tuning Dials

To adjust the tuning dials so that correct frequencies are indicated, it is necessary to operate the equipment. Connect the receiver to the power supply. Perform the starting operations as described in paragraph 16. If a signal generator is not available, connect the antenna to the receiver so that signals may be received.

a. Adjustment of Receiver Tuning Dial.

(1) Remove the receiver from the case and remove the side cover from the RF, local oscillator, and mixer section shield (fig. 30).

(2) Tune the receiver to a signal of known frequency. While holding the tuning knobs firmly to prevent rotation, loosen the set screws on the tuning capacitor shaft coupling (fig. 30).

(3) Without rotating the tuning capacitor, set the dial to the exact frequency being received. Tighten the set screws on the shaft coupling.

(4) For perfect tracking throughout each band, the receiver may have to be realined (par. 75).

b. Adjustment of Calibrating-Oscillator Tuning Dial.

(1) Remove the side cover from the calibrating-oscillator section shield (fig. 31).

(2) Set both the receiver and calibrating oscillator to the same band, and tune both to the same frequency.

(3) Press the PUSH TO CAL. switch and hold it in.

(4) Rock the calibrating-oscillator tuning knob to peak the signal output on signal level meter M101.

(5) While holding the tuning knobs firmly to prevent rotation, loosen the set screws on the tuning capacitor shaft coupling.

(6) Without rotating the tuning capacitor, set the calibrating-oscillator dial to the exact frequency indicated on the receiver tuning dial. Tighten the set screws on the shaft coupling.

(7) For perfect tracking throughout each band, the calibrating oscillator may have to be realined (par. 76).

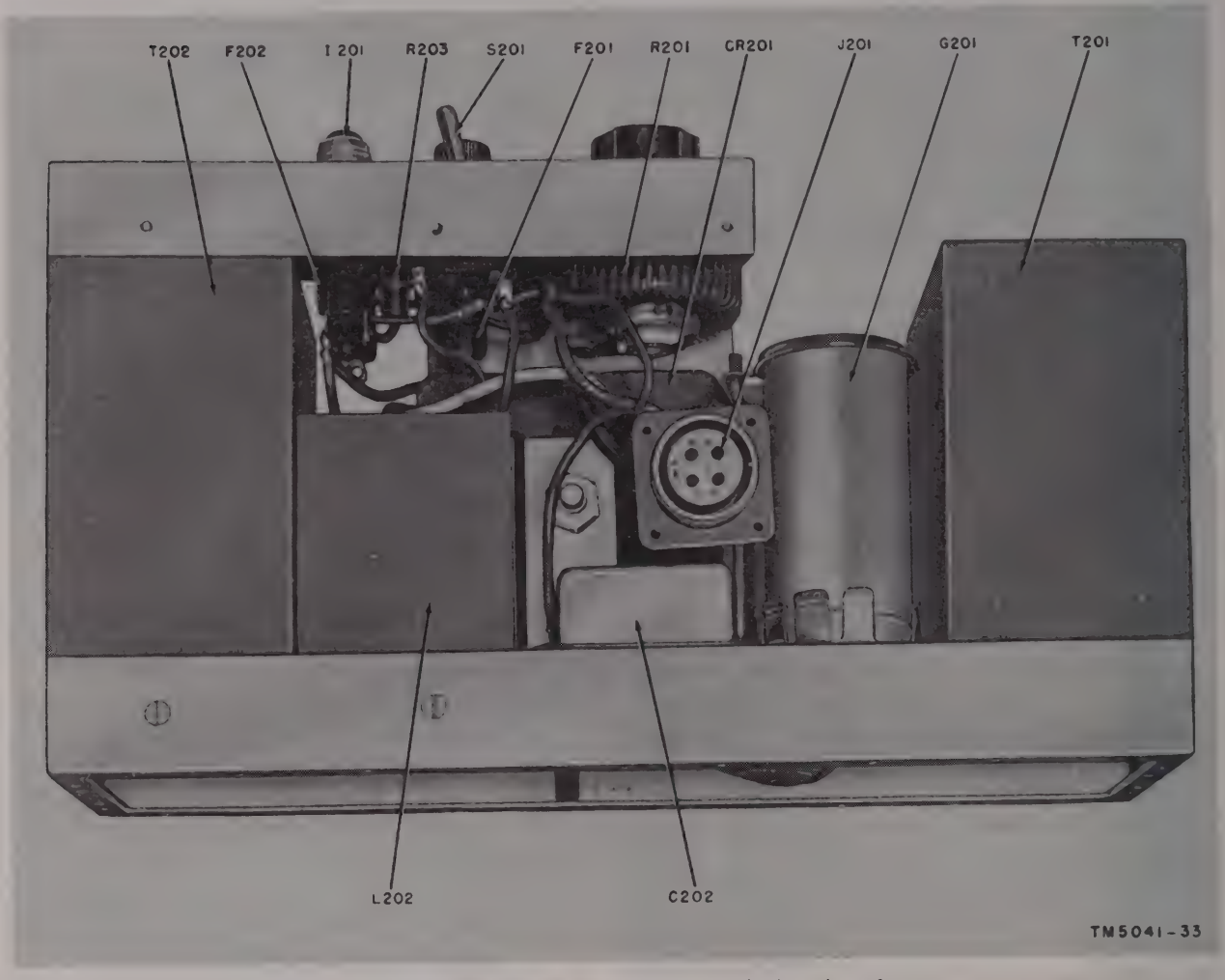


Figure 33. Side view of power-supply chassis, location of parts.

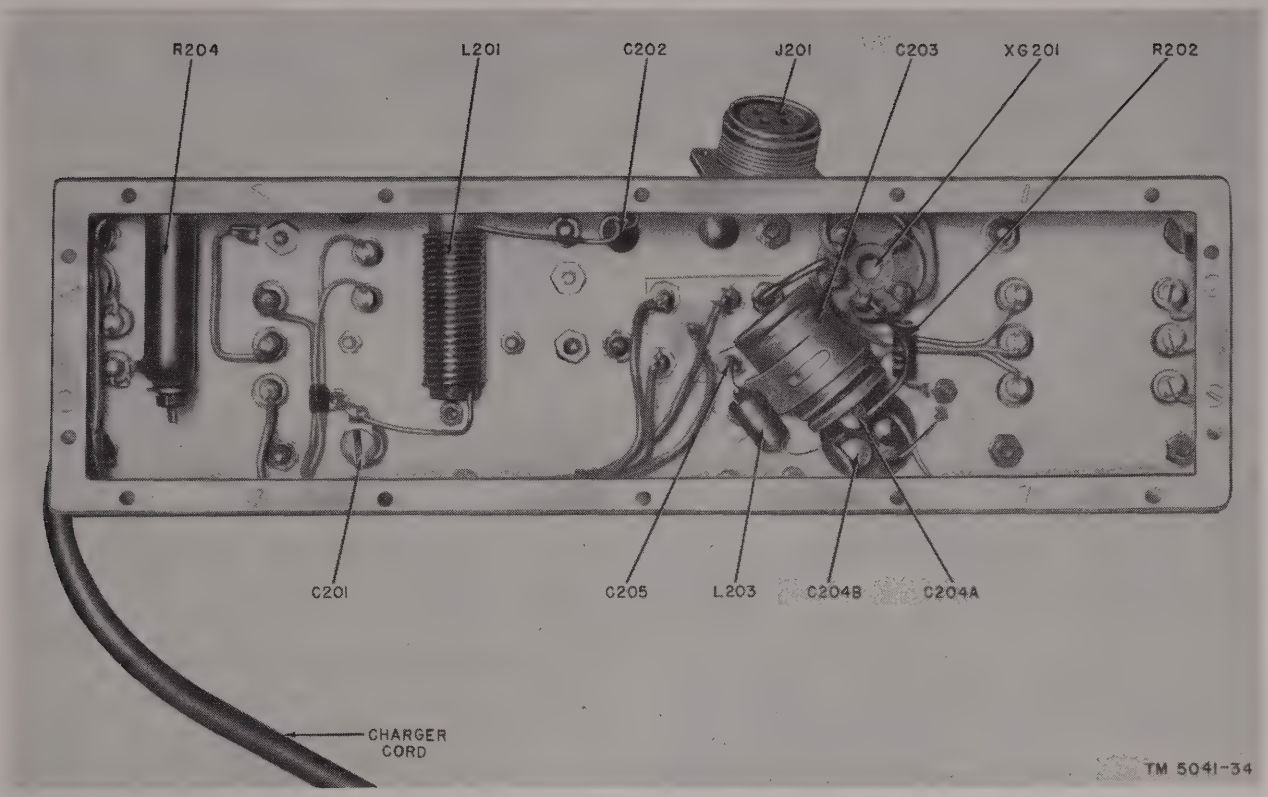


Figure 34. Bottom view of power-supply chassis, location of parts.

Section III. ALINEMENT AND CALIBRATION

74. Alinement of IF Amplifiers

To aline the IF amplifiers, follow the procedures given in *a* through *k* below.

a. Connect the receiver to the power supply and perform the starting operations described in paragraph 16.

b. Set the following controls at the positions specified:

(1) FM DISCRIMINATOR switch at OFF.
(2) GAIN control at 10.
(3) RESPONSE switch at SHARP.
(4) OUTPUT switch at LIN.

c. Disconnect the cable between IF attenuator Z101B and input IF transformer T103 at the attenuator end.

d. Loosen the locknuts on the top and bottom of IF transformers T104, T105, T106, and T107, and the locknut on the bottom of T103.

e. Set the RF signal generator to 10.7 mc, with an output level enough to give an on-scale reading on meter M101. Connect the signal generator output to the open connector of the cable to T103.

f. Use an insulated alinement screwdriver and adjust the top screw (secondary) of T107 for maximum output as observed on signal level meter M101. Adjust the bottom screw (primary) of T107 for maximum output.

Note. If the receiver is badly out of alinement, output may not be observed when the signal is applied to IF attenuator Z101B. If this is true, move the signal generator connection to the control grid (pin 1) of fourth IF amplifier V107 and adjust T107 as instructed in *f* above. Continue this procedure for each IF amplifier in turn, applying the signal to the control grid of the tube while adjusting the transformer in the plate circuit of the same tube.

g. Readjust the GAIN control for an on-scale reading. Repeat the procedure in *f* above for IF transformer T106. Readjust the GAIN control and repeat this procedure for T105 and T104.

h. Adjust the screw on the bottom or secondary of T103 for a maximum output reading.

i. Repeat the procedures in *f*, *g*, and *h* above for finer adjustment.

j. Remove the signal generator output and tighten all the locknuts.

k. Reconnect the IF attenuator cable.

75. Alinement of RF Section

To aline the RF section of the receiver, follow the procedure given below:

a. Remove the side plate from the RF section shield.

b. Set the controls as listed in paragraph 74*b*. Set the ATTENUATOR control at the 0 position.

c. Connect a 10.7-mc signal generator output of about 5 microvolts to the plate of V103 (pin 1). Loosen the locknut on the adjusting screw of T102 and adjust for a maximum reading on meter M101.

d. Tune the receiver and the hf signal generator to 18 mc. Set the RF TRIMMER to the 0 position.

e. Connect the signal generator output (about 5 microvolts) to the antenna connector (par. 57*a*). Retune the receiver for maximum output.

f. Adjust the oscillator tuning slug in T111 for a maximum reading on meter M101. Set the ATTENUATOR control to a step that will produce an on-scale reading, and vary the GAIN control during alinement to maintain on-scale readings.

g. Adjust the RF amplifier tuning slug of T101 for a maximum reading on meter M101.

h. Tune the receiver and the signal generator to 35 mc. Retune the receiver for maximum output. Adjust the oscillator trimmer capacitor C185 for a maximum reading on meter M101.

i. Repeat the procedure in *f* and *g* above for the two higher bands; retune to the low and then the high end of each band as necessary. Adjust the coil tuning slugs on the oscillator and RF amplifier at the low ends of the bands. Adjust the oscillator trimmer capacitors at the high end of the bands.

76. Alinement of Calibrating Oscillator

a. Set the receiver and the calibrating oscillator to exactly 18 mc. Set the RF TRIMMER control at 0.

b. Turn the CALIBRATE SWITCH to the ON position and adjust the OSCILLATOR OUTPUT control until a red-line indication appears on meter M102.

c. With the PUSH TO CAL. switch held down, adjust the tuning slug in T110 for a maximum reading on meter M101.

d. Set the receiver and the calibrating oscillator to exactly 35 mc without changing bands.

e. With the PUSH TO CAL. switch held down, adjust the trimmer capacitor in T110 for a maximum indication on the meter.

f. Repeat the procedure in *a* through *e* above for band B at 33 and 66 mc, and for band C at 62 and 125 mc.

g. Test for a red-line indication on meter M102 on all three bands.

77. Adjustment of R155

The setting of R155 should be checked periodically to insure a 10,000-microvolt output from the calibrating oscillator. The setting should also be checked after any repairs have been made to the receiver, especially after the thermocouple has been replaced. Refer to paragraph 79 for instructions.

78. Logarithmic Scale Adjustments

a. Perform the starting operations as described in paragraph 16.

b. Set the ATTENUATOR switch to 54, the GAIN control to 8, the RESPONSE switch to BROAD, the FM DISCRIMINATOR switch to OFF, the OUTPUT switch to LOG, and the CALIBRATE SWITCH to OFF.

c. Connect the output of the hf signal generator to the antenna connector of the receiver (par. 57*a*).

d. Adjust the hf signal generator for an unmodulated output of 20 mc and tune the receiver to the frequency of the signal generator.

e. Tune the receiver for a peak indication on signal level meter M101.

f. Adjust the hf signal generator output to 100 microvolts.

g. Adjust the GAIN control and the ATTENUATOR control until a reading of 0 db on the red DB (log) scale of meter M101 is obtained. Leave the GAIN and ATTENUATOR controls unchanged for the adjustments given in *h* through *j* below.

h. Increase the signal generator output by 20 db (1 millivolt). Adjust log-centering potentiometer R135 until a reading of 20 db is obtained on the red DB (log) scale of the meter.

i. Increase the hf signal generator output by an additional 20 db (10 millivolts total). Adjust log-range potentiometer R138 until receiver signal level meter M101 indicates full scale.

j. Repeat the procedures in *f* through *i* above to insure that the red DB (log) scale on meter M101 agrees with the hf signal generator output settings.

79. Calibration Procedure After Replacement of Thermocouple

a. Turn the receiver POWER switch to the START position and zero the signal level meter; turn the POWER switch to the ON position and zero the meter again.

b. Set the ATTENUATOR control at 66, the GAIN control at 10, the RESPONSE control at SHARP, the FM DISCRIMINATOR switch at OFF, the OUTPUT switch at LIN, and the CALIBRATE SWITCH at OFF.

c. Connect the output of the hf signal generator to the ANTENNA connector of the receiver through the antenna cable and through a matching network of known loss.

d. Adjust the output of the hf signal generator so that a signal of 10 millivolts at 75 mc is applied to the ANTENNA connector of the receiver.

e. Tune the receiver to the frequency of the hf signal generator.

f. Adjust the GAIN control until the signal level meter indicates +14 db. Do not change the setting of the GAIN control during the remainder of the procedure.

g. Set the CALIBRATE SWITCH at ON CAL. OSC. Allow at least 15 seconds for the calibrating oscillator to warm up. Press the PUSH TO CAL. switch and tune the CAL OSC FREQUENCY control to the frequency of the receiver. Adjust the RF TRIMMER control for peak output.

h. Vary the OSCILLATOR OUTPUT control until signal level meter M101 indicates +14 db. Adjust resistor R155 (fig. 26) until the needle of calibration meter M102 points to the red line.

i. Repeat the procedure in *d* through *h* above as an additional check.

Caution: When adjusting resistor R155, do not permit the needle of meter M102 to deflect beyond the red line. Overdriving the thermocouple can damage it.

Section IV. FINAL TESTING

80. General

This section is intended as a guide to be used in determining the quality of a repaired Field Strength Meter AN/URM–91. The minimum test requirements may be performed by maintenance personnel with adequate test equipment and necessary skills. Repaired equipment meeting these requirements will furnish uniformly satisfactory operation.

81. Test Equipment Required for Final Testing

The equipment required for final testing is the same as that used in troubleshooting, alinement, and calibration. Refer to paragraph 51.

82. General Performance Test

a. Connect the receiver, the power supply, and the antenna as described in paragraphs 11 and 12. Perform the starting operations as described in paragraph 16.

b. Tune in the receiver to transmitters of known frequency and power while adjusting the antenna dipole length and orientation as required. Include at least one frequency on each band.

c. Where conditions prevent completion of the procedure in *b* above, use the output of a signal generator as a substitute for actual transmitted signals.

83. Attenuator Accuracy Test

a. Perform the starting operations as described in paragraph 16. Set the CALIBRATE SWITCH to OFF, the OUTPUT switch to LIN, and the RESPONSE switch to SHARP.

b. Connect an RF signal generator with a 92-ohm balanced output to the ANTENNA connector. The signal generator must have an accurately calibrated output scale, graduated in microvolts.

c. Perform the test by feeding a signal to the receiver and adjusting the GAIN control for a 14-db indication on the DECIBELS scale of signal level meter M101. Set the ATTENUATOR control to a higher attenuation step, and increase the signal generator output by the same attenuation ratio so that the signal level

meter reading is maintained at 14 db. The variation in the meter reading from the 14-db level constitutes the error introduced by the RF and IF attenuators. Perform the tests at 20, 50, 75, and 120 megacycles.

d. The following table specifies the settings at which the tests are to be performed at each frequency. The ATTENUATOR column gives the first and second attenuator settings. The INPUT column gives the first and second input levels from the signal generator. Readjust the GAIN control at each first attenuator setting and at every frequency change.

ATTENUATOR (db)	INPUT (microvolts)
0–80	5–50,000
0–14	10–50
14–26	25–100
26–40	100–500
40–54	500–2,500
54–66	2,500–10,000
66–80	10,000–50,000

e. The maximum error for the 0- to 80-db test should be —1.2 db. All other tests should indicate a maximum error of ±.6 db.

84. Field-Strength Accuracy Test

a. Perform the starting operations as described in paragraph 16.

b. Calibrate the gain of the receiver as described in paragraph 17. Do not reset the GAIN control when performing the procedures in *c* through *h* below.

c. Connect the output of an RF signal generator with a 92-ohm balanced output to ANTENNA connector J101. The signal generator must have an accurately calibrated output scale graduated in microvolts.

Note. Only a 92-ohm balanced output signal generator can be used for this test. Use of a 50-ohm unbalanced output signal generator in conjunction with the impedance-matching network will introduce unknown losses and affect the accuracy of this test.

d. Set the signal generator output level at 100 microvolts.

e. Turn the CALIBRATE SWITCH to OFF and the OUTPUT switch to LIN. Tune the receiver and the signal generator to 20 megacycles.

f. Adjust the ATTENUATOR control to a setting that will produce an on-scale reading on signal level meter M101.

g. The reading on the DECIBELS scale of the signal level meter, added to the attenuator setting, should equal the signal generator output of 100 microvolts expressed as 40 db.

h. Repeat the test at 50, 75, and 120 megacycles. Maximum error between the meter reading and signal generator output should be +.5 db.

85. Frequency Accuracy Test

a. Perform the starting operations as described in paragraph 16.

b. Calibrate the gain of the receiver as described in paragraph 17.

c. Tune the receiver to a signal of known frequency and observe the accuracy of the tuning dial indication.

d. Throw the RESPONSE switch to the SHARP position.

e. Tune the calibrating oscillator to the received frequency. Press the PUSH TO CAL. switch and rock the CAL OSC FREQUENCY control for a peak meter reading. Observe the calibrating-oscillator tuning dial for accuracy of indication and agreement with the receiver tuning dial.

f. If tuning dial indications are noticeably inaccurate, correct them by following the procedures in paragraph 73.

CHAPTER 7

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

86. Disassembly

The following instructions are recommended as a guide for preparing Field Strength Meter AN/URM–91 for transportation and storage.

a. Disconnect all leads and power cords.

b. Replace the power cord in the power supply (fig. 32) and secure the cover with the latches.

c. Roll up the antenna cable and replace it in the antenna case (fig. 5).

d. Disassemble Antenna AS–802/URM–91 and place it in the antenna case (fig. 5) after placing the antenna and the tripod in their respective canvas bags. Be sure to tighten the web straps to hold the antenna sections and the tripod securely.

e. Close the antenna carrying case cover and secure it with the latches.

f. Remove the two Batteries BA–34 from the receiver, replace the cover on the unit, and secure it with the latches.

g. Remove the storage batteries according to the instructions given in paragraph 72*b*.

87. Repacking

a. General. If the original packing materials are on hand, use them. General repacking information is usually available at depots. Pack the equipment so as to prevent damage during transit or limited storage. Package the equipment securely and use sufficient wadding to minimize the effects of severe jolting. Make sure that the equipment is protected from rain and snow.

b. Materials Required.

(1) The following materials are required for packaging the field-strength meter:

Materials	Amount
Waterproof barrier	35 sq ft.
Single-faced, corrugated, fiberboard	70 sq ft.
Gummed paper tape	100 ft.
Water-resistant, pressure-sensitive, 3-inch tape	35 ft.
Steel strapping, 5/8 inch by .020 inch	30 ft.
Wooden shipping boxes	3.
Inner corrugated fiberboard cartons	3.
Outer corrugated fiberboard cartons	3.

(2) The dimensions of the three wooden boxes are as follows:

Box No.	Inner dimensions			Board feet	Volume (cu ft)	Packed weight (lb)
	Height (in.)	Width (in.)	Depth (in.)			
1 of 3	16½	23	16	115	3.51	61
2 of 3	11	19	12	84	1.34	63
3 of 3	12½	43	14½	140	4.52	70

(3) The dimensions of the inner corrugated fiberboard cartons are as follows:

Box No.	Inner dimensions			Material thickness (in.)	Cubic feet (estimated)	Packed weight (lb)
	Height (in.)	Width (in.)	Depth (in.)			
1 of 3	16	22½	15½	¼	3.22	57
2 of 3	10½	18½	11½	¼	1.23	59
3 of 3	12	42½	14	¼	4.13	66

(4) The dimensions of the outer corrugater fiberboard cartons are as follows:

Box No.	Inner dimensions			Material thickness (in.)	Cubic feet (estimated)	Packed weight (lb)
	Height (in.)	Width (in.)	Depth (in.)			
1 of 3	16¼	22¾	15¾	¼	3.41	58
2 of 3	10¾	18¾	11¾	¼	1.30	60
3 of 3	12¼	42¾	14¼	¼	4.30	67

c. Packaging.

(1) Cushion the six sides of the closed carrying cases with pads of corrugated, single-faced, flexible paper and secure the paper with gummed paper tape. Place the prepared carrying cases in the inner cartons and seal the cartons with gummed paper tape.

(2) Wrap the sealed cartons with waterproof barrier material; cut the material at least 12 inches longer than the width of the cartons, and seal the material with pressure-sensitive tape.

(3) Place the wrapped cartons in the outer cartons and seal the cartons with pressure-sensitive tape.

d. Construction of Boxes. Construct three wooden boxes (*b*(2) above). Nail two exterior cleats, running across the grain, on each end of the box (fig. 6). The cleats should extend to within one-eight inch of the outside edges of the top and bottom; the sides of the box should extend over the cleats.

e. Packing.

(1) Line the wooden boxes with waterproof barrier material.

(2) Place the sealed outer cartons in the wooden boxes and fill all spaces with pads of corrugated fiberboard.

(3) Seal the waterproof barrier material and nail on the tops of the wooden boxes.

(4) Apply two bands of steel strapping to each wooden box.

f. Marking. Mark the shipping containers in accordance with the requirements of SR 55–720–1, section II, Transportation and Travel, Preparation for Oversea Movement of Units (POM).

Section II. DEMOLITION OF MATERIEL TO PREVENT ENEMY USE

88. General

The demolition procedures outlined in paragraph 89 will be used to prevent the enemy from using or salvaging the equipment. Demolition will be accomplished only upon order of the commanding officer.

89. Methods of Destruction

Use any or all of the following methods to destroy the equipment.

a. Smash. Smash the controls, tubes, coils, switches, capacitors, transformers, antenna components, batteries, headsets, and carrying cases; use sledges, axes, handaxes, pickaxes, hammers, crowbars, or other heavy tools.

b. Cut. Cut cords, cables, and wiring; use axes, handaxes, or machetes.

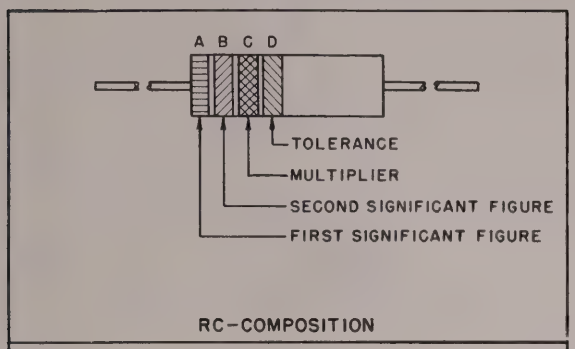
c. Burn. Burn cords, wiring, and manuals; use kerosene, oil, flame throwers, or incendiary grenades.

d. Dispose. Bury the destroyed parts in slit trenches, foxholes, or other holes, or throw them into streams.

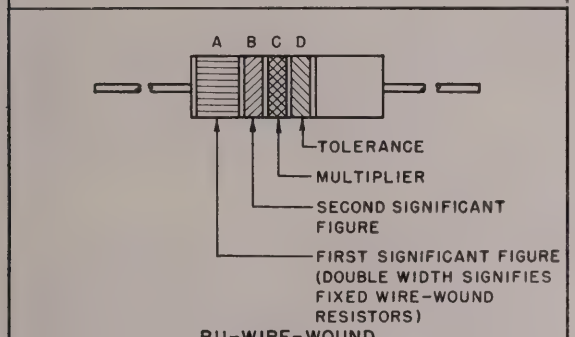
Note. Use anything immediately available for the destruction of this equipment.

RESISTOR COLOR CODE MARKING
(MIL-STD RESISTORS)

AXIAL-LEAD RESISTORS (INSULATED)

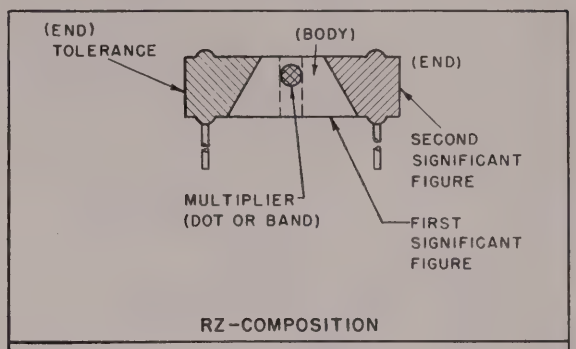


RC-COMPOSITION

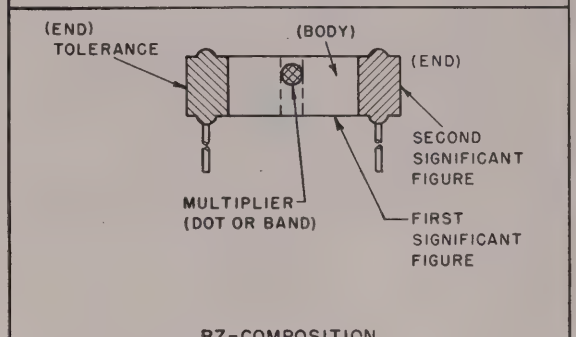


RU-WIRE-WOUND

RADIAL-LEAD RESISTORS (UNINSULATED)



RZ-COMPOSITION



RZ-COMPOSITION

RESISTOR COLOR CODE

BAND A OR BODY*		BAND B OR END*		BAND C OR DOT OR BAND*		BAND D OR END*	
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)
BLACK	0	BLACK	0	BLACK	1	BODY	± 20
BROWN	1	BROWN	1	BROWN	10	SILVER	± 10
RED	2	RED	2	RED	100	GOLD	± 5
ORANGE	3	ORANGE	3	ORANGE	1,000		
YELLOW	4	YELLOW	4	YELLOW	10,000		
GREEN	5	GREEN	5	GREEN	100,000		
BLUE	6	BLUE	6	BLUE	1,000,000		
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7				
GRAY	8	GRAY	8	GOLD	0.1		
WHITE	9	WHITE	9	SILVER	0.01		

*FOR WIRE-WOUND-TYPE RESISTORS, BAND A SHALL BE DOUBLE-WIDTH. WHEN BODY COLOR IS THE SAME AS THE DOT (OR BAND) OR END COLOR, THE COLORS ARE DIFFERENTIATED BY SHADE, GLOSS, OR OTHER MEANS.

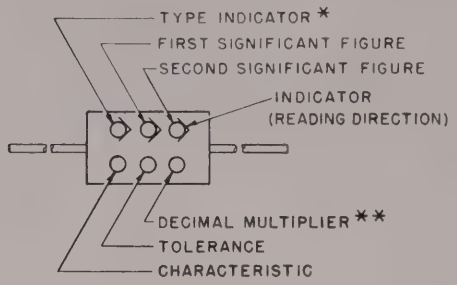
EXAMPLES (BAND MARKING):
10 OHMS ±20 PERCENT: BROWN BAND A; BLACK BAND B; BLACK BAND C; NO BAND D.
4.7 OHMS ±5 PERCENT: YELLOW BAND A; PURPLE BAND B; GOLD BAND C; GOLD BAND D.

EXAMPLES (BODY MARKING):
10 OHMS ±20 PERCENT: BROWN BODY; BLACK END; BLACK DOT OR BAND; BODY COLOR ON TOLERANCE END.
3,000 OHMS ±10 PERCENT: ORANGE BODY; BLACK END; RED DOT OR BAND; SILVER END.

STD-RI

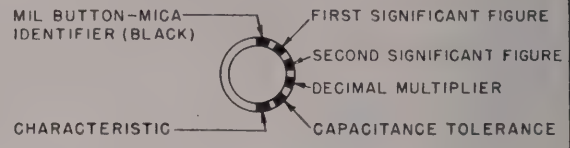
Figure 35. MIL STD resistor color codes.

CAPACITOR COLOR CODE MARKING
(MIL-STD CAPACITORS)

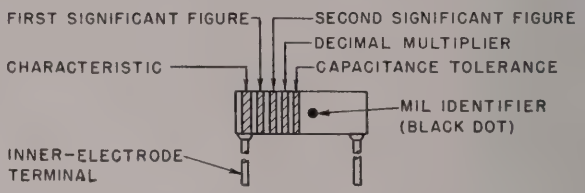


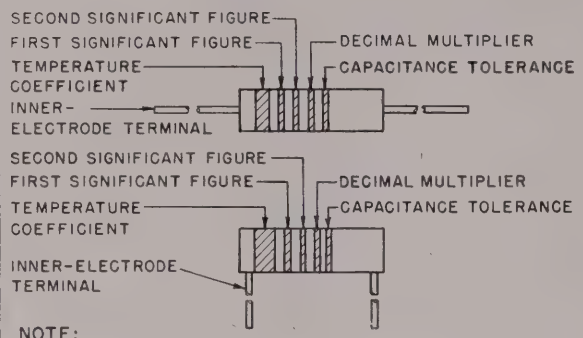
* BLACK DOT: MICA DIELECTRIC
SILVER DOT: PAPER DIELECTRIC
** INDICATES NUMBER OF ZEROS ON PAPER TYPE.

MICA (CM) AND PAPER (CN)



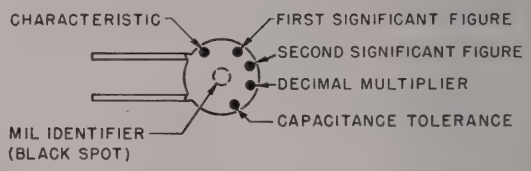
BUTTON-MICA (CB)





NOTE:
SPOTS MAY BE USED INSTEAD OF BANDS; TEMPERATURE COEFFICIENT MARKING IS LARGER.

CERAMIC-TEMPERATURE COMPENSATING (CC)



NOTES:
1. SPOTS MAY BE USED ON TUBULAR CAPACITORS; CHARACTERISTIC SPOT IS LARGER AND MIL IDENTIFIER IS ON SIDE DIAMETRICALLY OPPOSITE COLOR SPOTS.
2. MIL IDENTIFIER OF DISK TYPE IS ON REVERSE SIDE; CHARACTERISTIC SPOT IS LARGER OR SPACE BETWEEN CHARACTERISTIC AND TOLERANCE SPOTS IS THREE TIMES SPACE BETWEEN ADJACENT SPOTS.
3. TOLERANCE: YELLOW, +100%, -20%.

CERAMIC-GENERAL PURPOSE (CK)

CAPACITOR COLOR CODE

COLOR	SIG FIG.	MULTIPLIER		CHARACTERISTIC[1]				TOLERANCE [2]					TEMPERATURE COEFFICIENT (UUF/UF/°C)
		DECIMAL	NUMBER OF ZEROS	CM	CN	CB	CK	CM	CN	CB	CC		
											OVER 10UUF	10UUF OR LESS	CC
BLACK	0	1	NONE		A			20	20	20	20	2	ZERO
BROWN	1	10	1	B	E	B	W				1		-30
RED	2	100	2	C	H		X	2		2	2		-80
ORANGE	3	1,000	3	D	J	D			30				-150
YELLOW	4	10,000	4	E	P								-220
GREEN	5		5	F	R						5	0.5	-330
BLUE	6		6		S								-470
PURPLE (VIOLET)	7		7		T	W							-750
GRAY	8		8			X						0.25	+30
WHITE	9		9								10	1	-330(±500) [3]
GOLD		0.1						5		5			+100
SILVER		0.01						10	10	10			

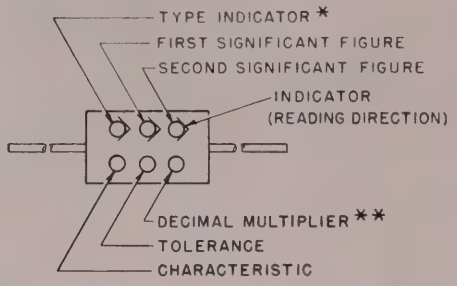
1. LETTERS ARE IN TYPE DESIGNATIONS GIVEN IN MIL-C SPECIFICATIONS.
2. IN PERCENT, EXCEPT IN UUF FOR CC-TYPE CAPACITORS OF 10 UUF OR LESS.
3. INTENDED FOR USE IN CIRCUITS NOT REQUIRING COMPENSATION.

STD-C1

Figure 36. MIL STD capacitor color codes.

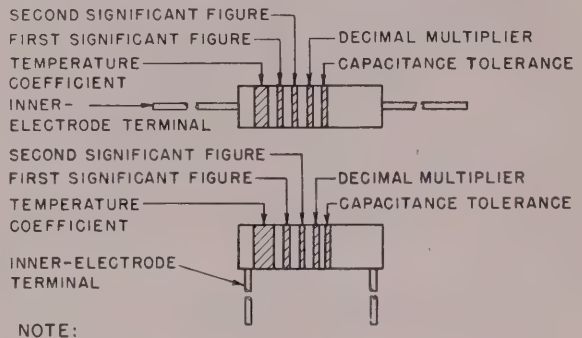
1. AL
RE
2. AL
BY
3. AL
TH
4. US
VC
5. AL
RE
PC
IN
PC
EX
RE
M
6. AL
DI
BA
NC
7. VC
AT
O
TC
8. W
P
IS
9. W
V
10. "
11. V
S
M
P
12. V
13. O

CAPACITOR COLOR CODE MARKING
(MIL-STD CAPACITORS)



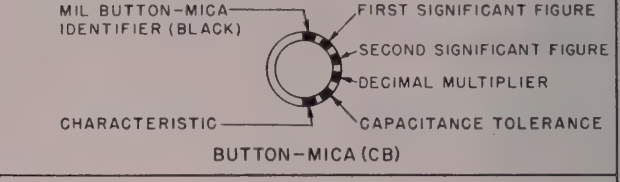
* BLACK DOT: MICA DIELECTRIC
SILVER DOT: PAPER DIELECTRIC
** INDICATES NUMBER OF ZEROS ON PAPER TYPE.

MICA (CM) AND PAPER (CN)

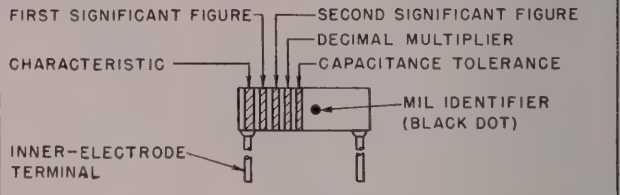


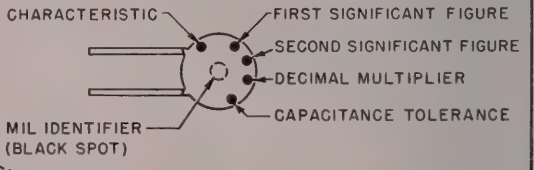
NOTE:
SPOTS MAY BE USED INSTEAD OF BANDS; TEMPERATURE COEFFICIENT MARKING IS LARGER.

CERAMIC-TEMPERATURE COMPENSATING (CC)



BUTTON-MICA (CB)





NOTES:
1. SPOTS MAY BE USED ON TUBULAR CAPACITORS; CHARACTERISTIC SPOT IS LARGER AND MIL IDENTIFIER IS ON SIDE DIAMETRICALLY OPPOSITE COLOR SPOTS.
2. MIL IDENTIFIER OF DISK TYPE IS ON REVERSE SIDE; CHARACTERISTIC SPOT IS LARGER OR SPACE BETWEEN CHARACTERISTIC AND TOLERANCE SPOTS IS THREE TIMES SPACE BETWEEN ADJACENT SPOTS.
3. TOLERANCE: YELLOW, +100%, -20%.

CERAMIC-GENERAL PURPOSE (CK)

CAPACITOR COLOR CODE

COLOR	SIG FIG.	MULTIPLIER		CHARACTERISTIC[1]				TOLERANCE [2]					TEMPERATURE COEFFICIENT (UUF/UF/°C)
		DECIMAL	NUMBER OF ZEROS	CM	CN	CB	CK	CM	CN	CB	CC		
											OVER 10UUF	10UUF OR LESS	CC
BLACK	0	1	NONE		A			20	20	20	20	2	ZERO
BROWN	1	10	1	B	E	B	W				1		-30
RED	2	100	2	C	H		X	2		2	2		-80
ORANGE	3	1,000	3	D	J	D			30				-150
YELLOW	4	10,000	4	E	P								-220
GREEN	5		5	F	R						5	0.5	-330
BLUE	6		6		S								-470
PURPLE (VIOLET)	7		7		T	W							-750
GRAY	8		8			X						0.25	+30
WHITE	9		9								10	1	-330(±500) [3]
GOLD		0.1						5		5			+100
SILVER		0.01						10	10	10			

1. LETTERS ARE IN TYPE DESIGNATIONS GIVEN IN MIL-C SPECIFICATIONS.
2. IN PERCENT, EXCEPT IN UUF FOR CC-TYPE CAPACITORS OF 10 UUF OR LESS.
3. INTENDED FOR USE IN CIRCUITS NOT REQUIRING COMPENSATION.

STD-CI

Figure 36. MIL STD capacitor color codes.

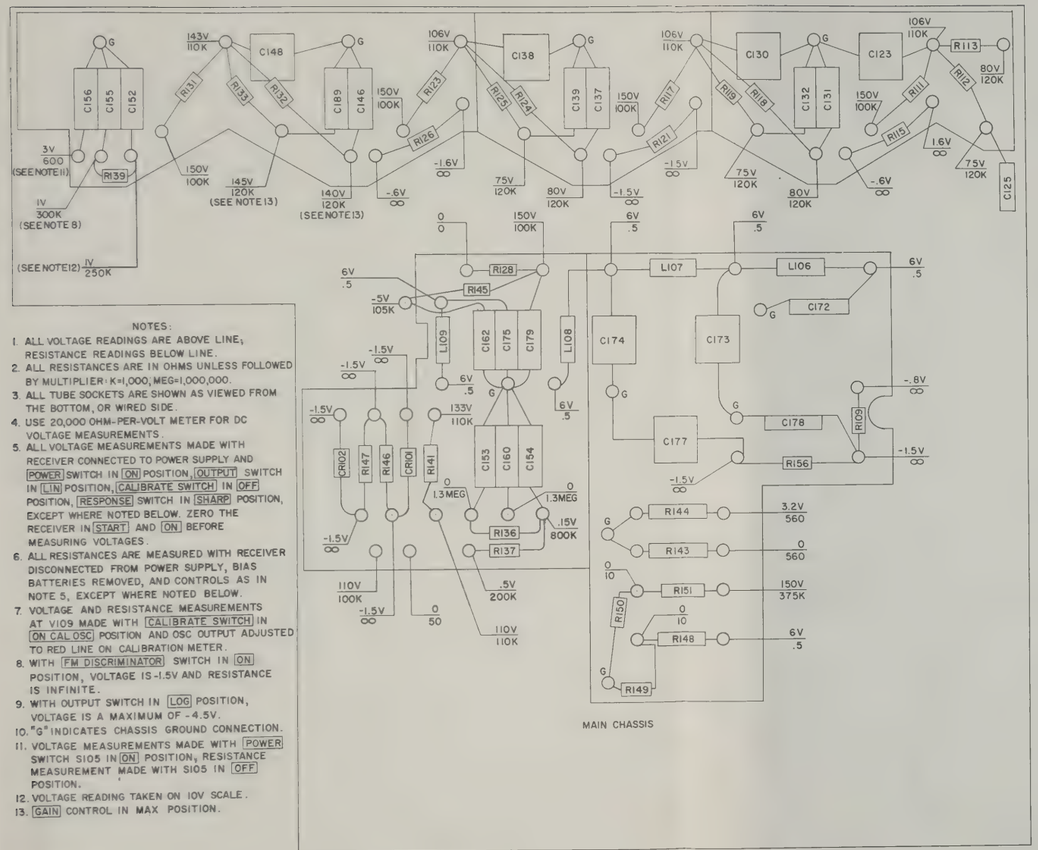


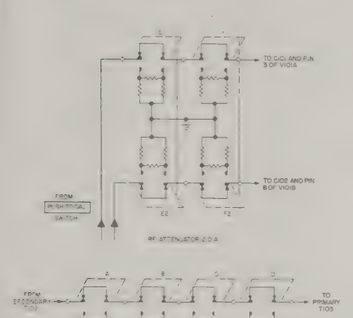
Figure 37. Voltage and resistance diagram.

TM5041-37

405662 O—1956

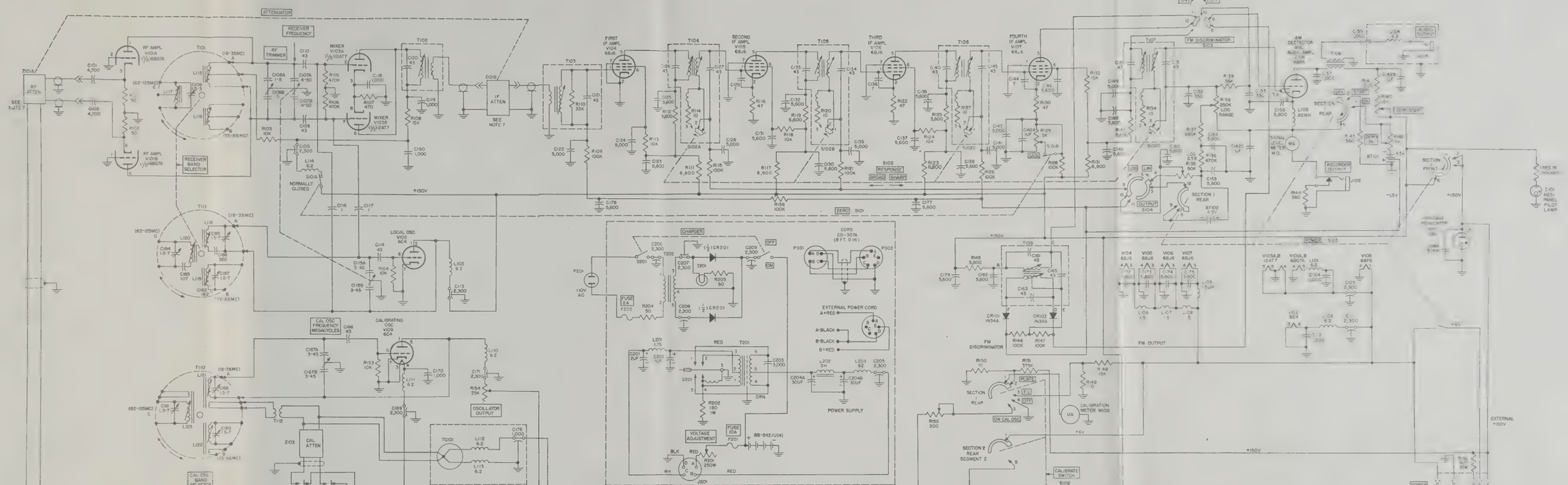
NOTES

1. RESISTOR VALUES ARE IN OHMS UNLESS FOLLOWED BY MULTIPLIER: K=1,000; MEG=1,000,000
2. CAPACITOR VALUES ARE IN MICROMICROFARADS "UUF"; UNLESS FOLLOWED BY "UF", MICROFARADS.
3. INDUCTANCE VALUES ARE IN MICROHENRIES; HENRIES ARE INDICATED BY H; MILLIHENRIES ARE INDICATED BY MH.
4. ALL RESISTORS ARE ½ WATT UNLESS OTHERWISE INDICATED.
5. ALL SWITCHES ARE VIEWED FROM THE CONTROL KNOB END SECTIONS DESIGNATED ARE NEAREST THE KNOB END SWITCHES S105 AND S106 SHOWN IN EXTREME COUNTERCLOCKWISE POSITION.
6. ALL CONNECTORS ARE SHOWN AS VIEWED FROM WIRESIDE.
7. ATTENUATOR NETWORKS ARE CONNECTED AS FOLLOWS:



ATTENUATION STEPS	ATTENUATOR NETWORKS CONNECTED	
	RF ATTENUATOR	IF ATTENUATOR
0	NONE	NONE
4	NONE	A
24	NONE	A B
40	NONE	A B C
56	NONE	A B C D
88	E1 E2	A B C D
90	E1 E2 F1 F2	A B C D

8. ▭ INDICATES EQUIPMENT MARKINGS.



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[AG 413.44 (3 Oct 56)]

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For explanation of abbreviations used, see SR 320–50–1.

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